AVENTICS

PNEUMATIC ACTUATORS & POSITIONERS

MOBILE TYPE AIR CYLINDERS

Rexroth
Pneumatics

AVENTICS

Section 1: SC-900 Pneumatic Actuators & Positioners

Single Direction Actuator Positioners
Two Direction Actuator Positioners

Section 2: SC-1000 Mobile Type Air Cylinders

Construction Grade (Cast Iron) Air Cylinders
Multi-Position Air Cylinders
Transmission Control Systems

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The products in this catalog are most often used in mobile, marine and oilfield applications. We manufacture many other standard products that are most often used in industrial applications. Visit our web site at www.aventics.com/us for details.

Single Directions Positioners

3 1/2 thru 36 lb. Thrust ratings - Fixed Strokes
Spring Controlled - Linear & Radial Motion Types
Piston & Diaphragm Constructions

Two Direction Positioners

1 3/4” & 3 1/4” bore sizes - Various Strokes
Spring Centered - Linear Motion
7 thru 25 lb. thrust ratings

Index for Section 2 (SC-1000) immediately follows page 14 of Section 1 (SC-900)

Note: Most service manuals can be downloaded from the web at: www.aventics.com/us

AVENTICS Actuator Positioners are compact, pneumatically operated devices used for accurate positioning of engine governor control arms, butterfly valves, carburetors and other low-force mechanisms.

AVENTICS offers three types of positioners: diaphragm-with radial motion lever, diaphragm-linear, and cylinder-linear. All three models use the same basic principle of applying a predetermined air pressure (supplied by a AVENTICS Type "H" Controlair® Valve or Type M PLUS™ proportional pressure control valve) to act on a diaphragm or piston to compress a positioning spring. The actuator lever then assumes a specific position which corresponds to the applied pressure and to the control valve handle position.

Our Actuator Positioners feature light-weight, strong, die-cast construction with a minimum of connections. Years of performance in heavy construction vehicles, drill rigs, marine applications, and other types of installations have proven them to be rugged and highly dependable.

STANDARD SPECIFICATIONS

MATERIALS
A-2-H—Die-cast aluminum utilizing close-fitting bearings with grease fittings.

AA TYPE—Cast aluminum utilizing close-fitting bearings with grease fittings.

"C" TYPE (small) Die-cast aluminum with chrome-plated piston rod.

"C" TYPE (large) Cast iron with chrome-plated piston rod.

"E" TYPE—Formed steel and cast aluminum with chrome-plated piston rod.

TWO DIRECTION POSITIONER—Die-cast aluminum with chrome-plated piston rod.

All positioners have long wearing synthetic rubber parts such as diaphragms and piston seals.

TEMPERATURE
All Models.....-40° F to 165° F
(-40° C to 74° C)

MEDIA
Air and inert gasses
(Consult factory for other uses)

PORTS
All models except Large 2D Positioner ...1/4 - 18 NPTF
(Large 2D Positioner .....3/8 - 18 NPT)

Compact, versatile actuators where fast response, accurate positioning and durability are needed.

PRESSURES Max. Supply Pressure 100 psig (6.89 bar)	
Model	†Operating Pressure PSIG (bar)
A-2-H	3-15 (0.21-1.03) 10-60 (0.69-4.14) 15-80 (1.03-5.52) 35-90 (2.41-6.21)
AA Type	10-60 (0.69-4.14)
"C" Type	10-60 (0.69-4.14)
"E" Type	10-60 (0.69-4.14) 10-90 (0.69-6.21)
2 Direction	10-60 (0.69-4.14) 10-90 (0.69-6.21)

† Control valve output pressure should match the positioner pressures.

FORCE RATING OUTPUT CHART
Strokes shown should be fully utilized.

A-2-H	*410 inch-lb. degrees (46 m-N) or 3.5 lbs. thru 2" (15.6N-50.8mm)
C-Linear (small)	*650 inch-lb. degrees (73 m-N) or 7 lbs. thru 1.5" (31.1N-38.1mm)
C-Linear (long)	*650 inch-lb. degrees (73 m-N) or 7 lbs. thru 3" (31.1N-76.2mm)
AA-AB-BA-1	*1125 inch-lb. deg. (127 m-N) or 10 lbs. thru 2" (44.5N-50.8mm)
C-Linear (large)	*1400 inch-lbs. deg. (158 m-N) or 15 lbs. thru 1.5" (66.7N-38.1mm)
12E	*4500 inch-lb. degrees (508 m-N) or 36 lbs. thru 2" (160N-50.8mm)

SPRING CENTERED POSITIONER (based on total travel)

R431004748	*410 inch-lb. degrees (46 m-N) or 7 lbs. thru 1" (31.1N-25.4mm)
R431005261	*820 inch-lb. degrees (93 m-N) or 7 lbs. thru 2" (31.1N-50.8mm)
R431006349	*820 inch-lb. degrees (93 m-N) or 7 lbs. thru 2" (31.1N-50.8mm)

* The force rating of the controlled device is found by multiplying the force required in pounds to move the lever, times the length of the lever in inches, times the total number of degrees of travel of the lever. Compare your results to the above chart force ratings and select the nearest rating. If your rating is between two of the ratings above always go to the next highest rating.

The AA Type actuators are the most powerful of the diaphragm-lever type positioners, with a force rating of 1125 inch -lb-degrees (127m-N). The AA Types are made in both Single (AA-1 and BA-1) and Two-Direction (AB-1) models. The AA Type are all easily mounted and take up a moderate amount of space.

Output Travel adjustable from 7/8" to 2 1/4" (22.2 to 57.2mm).

AA-1

Standard **Single Direction** Positioner.
The AB-1 and BA-1 are constructed from this basic model.

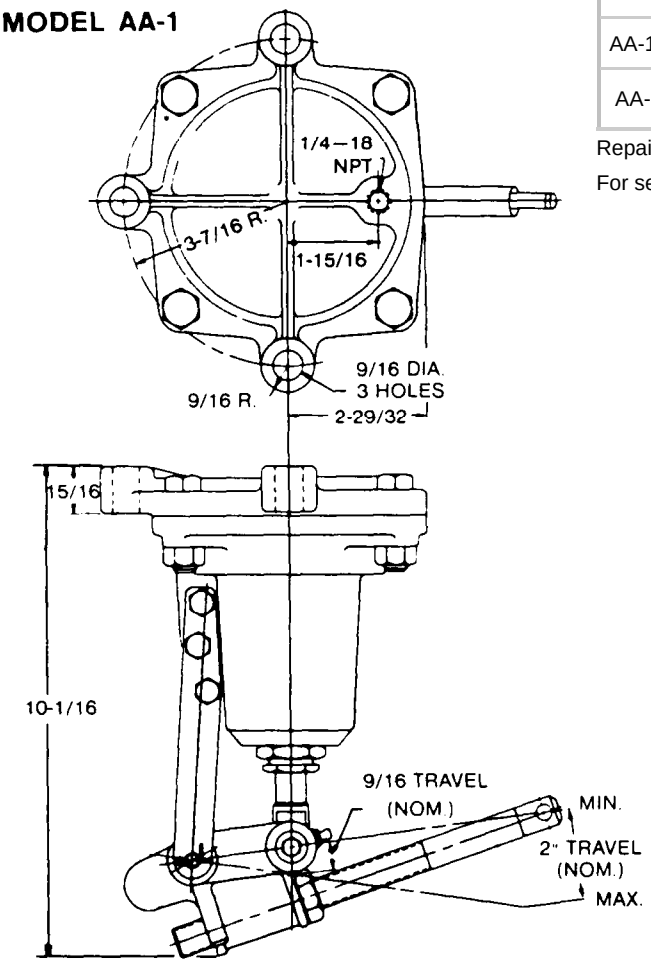
Ordering Information

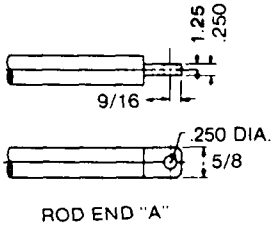
Model	Part No. (Old Part No.)	Pressure Range psi (bar)	Weight lbs. (kg)
AA-1 1/4" rod eye	R431005436 (P –060263-00001)	10 - 60 (0.69-4.14)	8.0 (3.63)
AA-1 5/16" rod eye	R431005437 (P –060263-00002)	10 - 60 (0.69-4.14)	8.5 (3.86)
AA-1 3/8" rod eye	R431005438 (P –060263-00003)	10 - 60 (0.69-4.14)	8.5 (3.86)

Repair kit: Part number R431006220 (old P –063381-00000)

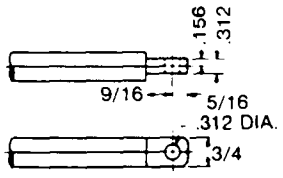
For service information, see service manual SM-900.4401

MODEL AA-1

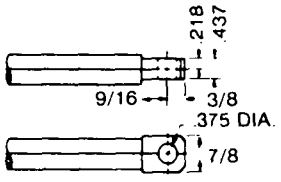




ROD END "A"



ROD END "B"



ROD END "C"

AB-1

Basic AB Type **Two-Direction** Positioner is made from the basic AA type and the addition of a separately controlled stop cylinder.

BA-1

Basic AA Type, **Single Direction** Positioner with a "vernier" feature added by the use of an additional diaphragm that is controlled separately. (An H-4 Controlair® Valve is a great combination.) This allows for exact positioning and very fine control.

Ordering Information

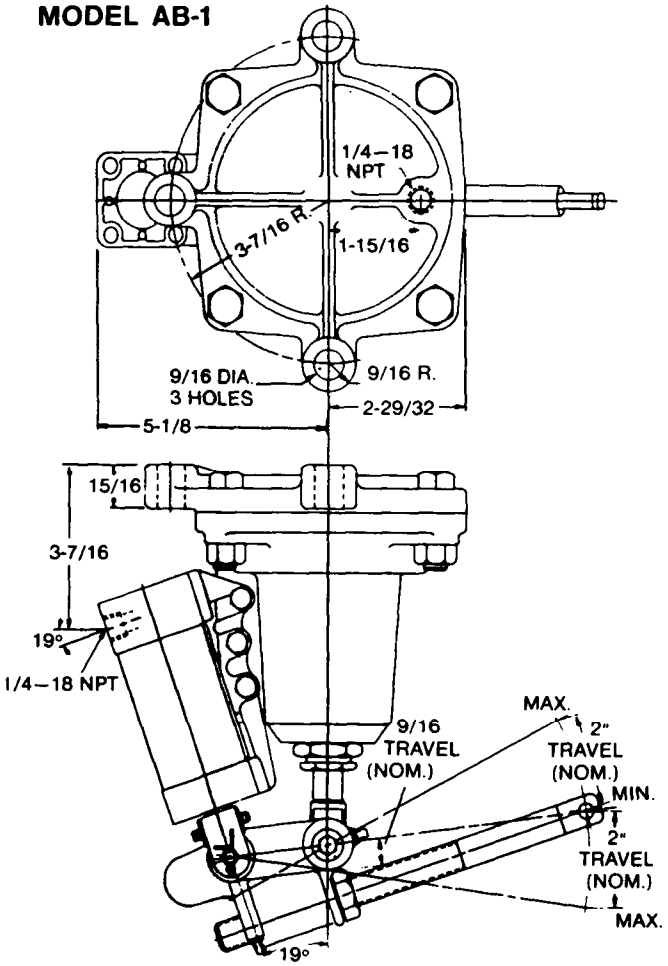
Model	Part No. (Old Part No.)	Pressure Range psi (bar)	Weight lbs. (kg)
AB-1 1/4" rod eye	R431005441 (P –060266-00001)	10 - 60 (0.69-4.14)	11.5 (5.22)
AB-1 5/16" rod eye	R431005442 (P –060266-00002)	10 - 60 (0.69-4.14)	11.5 (5.22)
AB-1 3/8" rod eye	R431005443 (P –060266-00003)	10 - 60 (0.69-4.14)	11.5 (5.22)
BA-1 1/4" rod eye	R431009018 (P –060269-00001)	10 - 60 (0.69-4.14)	11.0 (4.99)
BA-1 5/16" rod eye	R431005445 (P –060269-00002)	10 - 60 (0.69-4.14)	11.0 (4.99)
BA-1 3/8" rod eye	R431005446 (P –060269-00003)	10 - 60 (0.69-4.14)	11.0 (4.99)

Repair kit for AB-1: Part number R431006218 (old P –063379-00000)

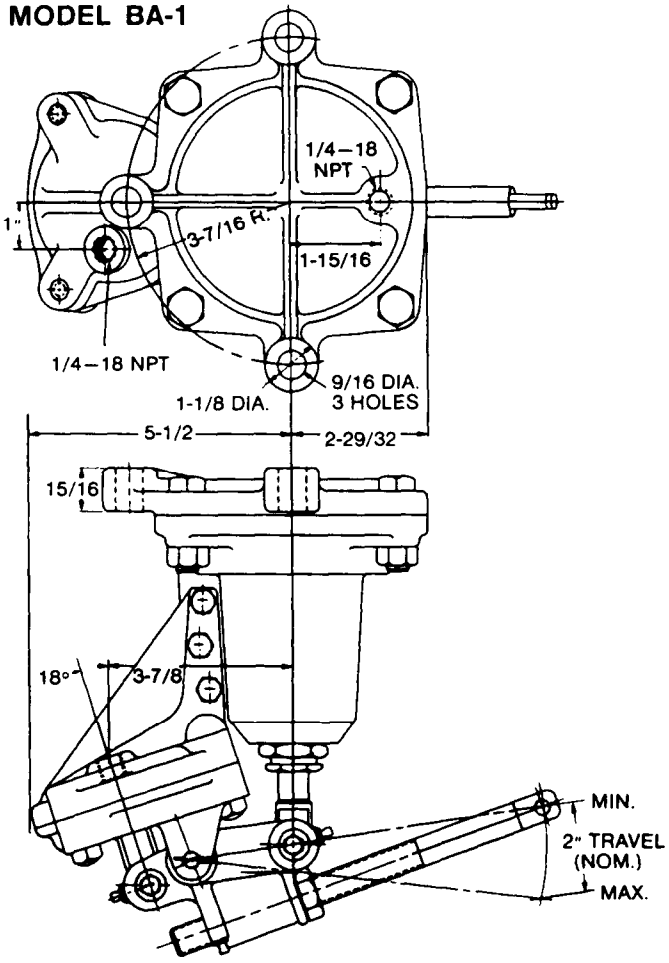
Repair kit for BA-1: Part number R431006219 (old P –063380-00000)

For service information, see service manual SM-900.4401

MODEL AB-1



MODEL BA-1



(shown less accessory kit)

Ordering Information

Pressure Range psi (bar)	With Accessories Part No. (Old Part No.)	Less Accessories Part No. (Old Part No.)	Accessory Kit Part No. (Old Part No.)	Actuator Weight lbs. (kg)
3 - 15 (0.21 -1.03)	R431005217 (P –059718-00011)	R431005216 (P –059718-00010)	R431004144 (P –057415-K0000)	3 (1.36)
10 - 60 (0.69-4.14)	R431004010 (P –057159-00011)	R431004009 (P –057159-00010)	R431004144 (P –057415-K0000)	3 (1.36)
10 - 60* (0.69-4.14)	R431004011 (P –057159-00012)	R431004009 (P –057159-00010)	R431004146 (P –057416-K0000)	3 (1.36)
15 - 80 (1.03-5.52)	R431004529 (P –058430-00011)		R431004144 (P –057415-K0000)	3 (1.36)
35 - 90 (2.41-6.21)	R431003984 (P –057086-00011)	R431003983 (P –057086-00010)	R431004144 (P –057415-K0000)	3 (1.36)

*With ball joint accessory instead of standard clevis.

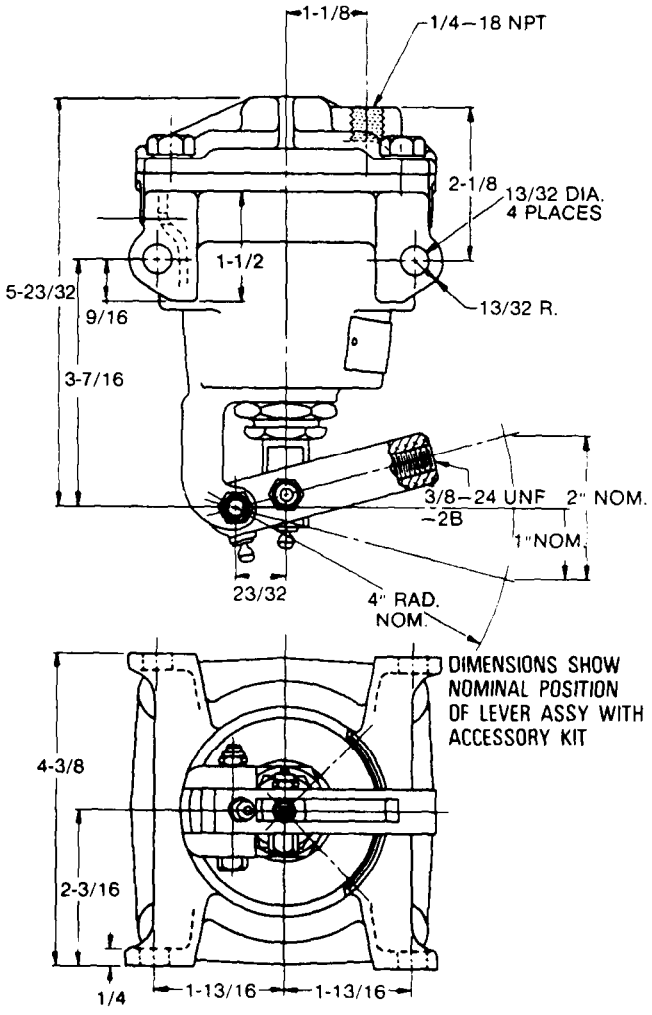
Part number R431005745 (old P –61289-00010) is 10-60 less accessories, with drain hole.

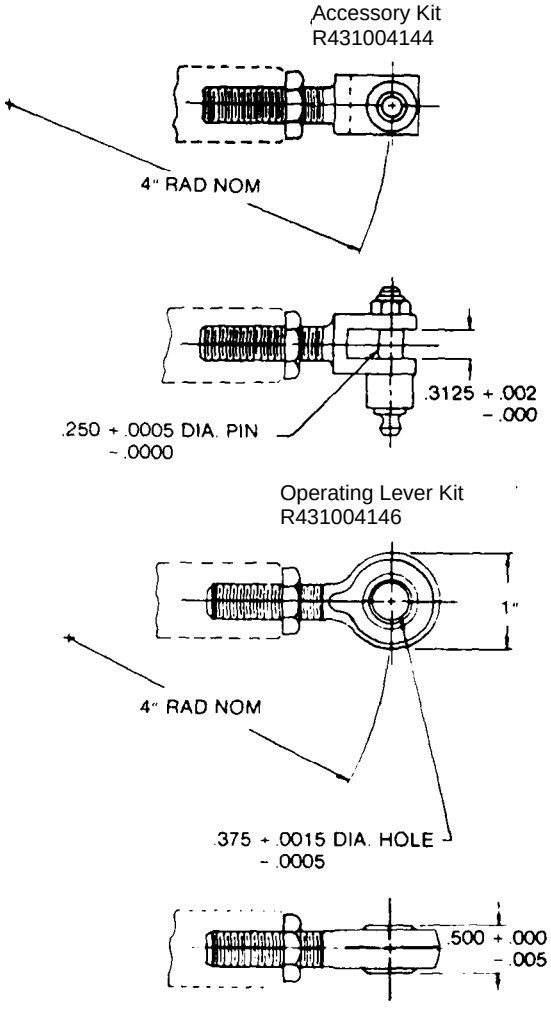
Major repair kit: Part number R431006212 (old P –063286-00000)

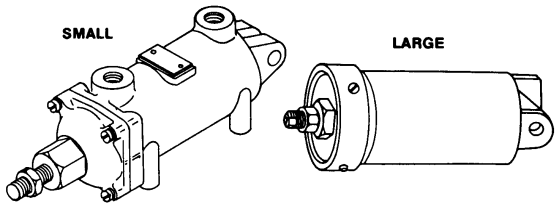
Minor repair kit: Part number R431005743 (old P –061278-K0000)

For service information, see service manual SM-900.4407

The A-2-H has the lowest power rating: 410 in-lb-degrees (46 m-N); this compares with the small “C” Type Linear Positioner of 650 in-lb-degrees (73 m-N), but has better accuracy due to the low-friction characteristics of its diaphragm operation. The A-2-H has a nominal stroke of 2”, adjustable from 1 7/8” to 2 1/4” (50.8mm, adjustable from 47.6 to 57.2). Integral mounting lugs make installation simple and clean.







Ordering Information

Model	Part No. (Old Part No.)	Pressure psi (bar)	Stroke in. (mm)	Weight lbs. (kg)
“C” Linear (small) with preload adj. nut	R431004882 (P –059023-00001)	10 - 60 (0.69-4.14)	1.5” (38.1)	2.5 (1.13)
“C” Linear (small) less preload adj. nut	R431004883 (P –059023-00002)	10 - 60 (0.69-4.14)	1.5” (38.1)	2.5 (1.13)
“C” Linear (small) less preload adj. nut	R431006478 (P –064713-00002)	8-80 (0.55-5.52)	1.5” (38.1)	2.5 (1.13)
“C” Linear (small) less preload adj. nut	R431006434 (P –064433-00000)	10 - 60 (0.69-4.14)	3” (76.2)	3 (1.36)
“C” Linear (large)	R431003945 (P –055952-00000)	10 - 60 (0.69-4.14)	1.5” (38.1)	9 (4.08)
“C” Linear (3.25” bore*)	R431009144 (P –065519-00000)	10 - 30 (0.69-2.07)	4” (101.6)	12 (5.44)

Repair kit for C small P-59023 & P-64713 series: R431005657 (old P –061051-00000)

Repair kit for C small R431006434: R431006593 (old P –065291-00000)

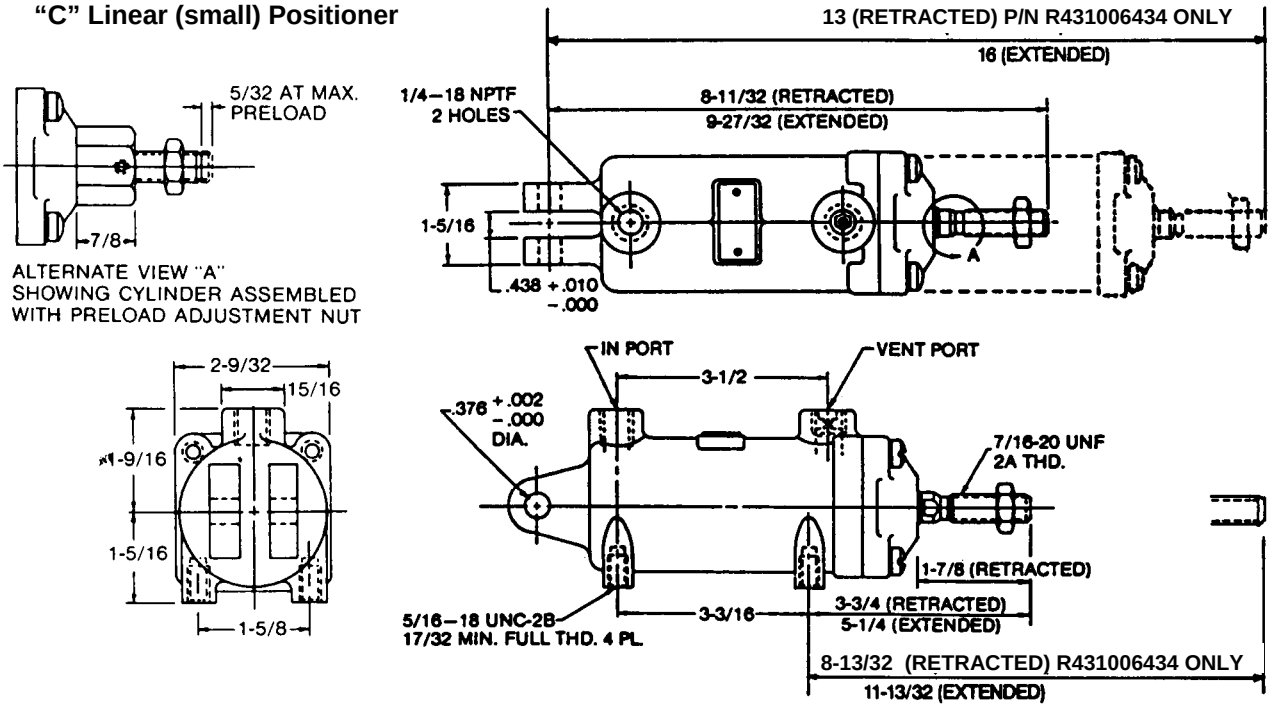
Repair kit for C large R431003945: R431004612 (old P –058613-00000)

*Drawing not shown for special 3.25” bore R431009144

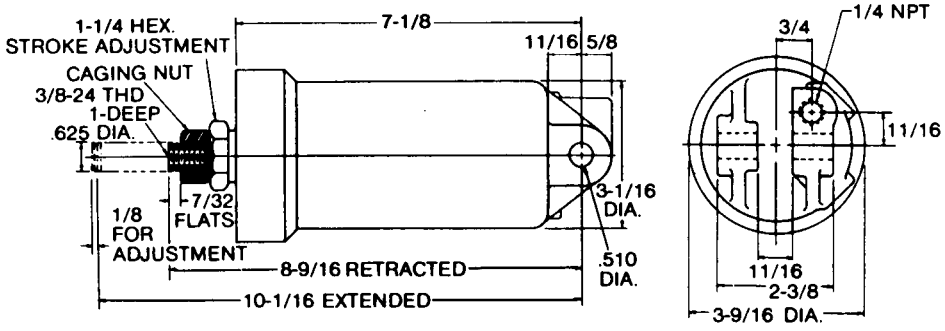
For service information, see service manual SM-900.4408

The “C” Type are the smallest and most economical of the positioners. They are linear piston type, with force characteristics of 650 inch-lb-degrees (73 m-N) and 1400 inch -lb-degrees (158 m-N). The “C” Type have integral female clevises for easy mounting.

“C” Linear (small) Positioner



“C” Linear (large) Positioner

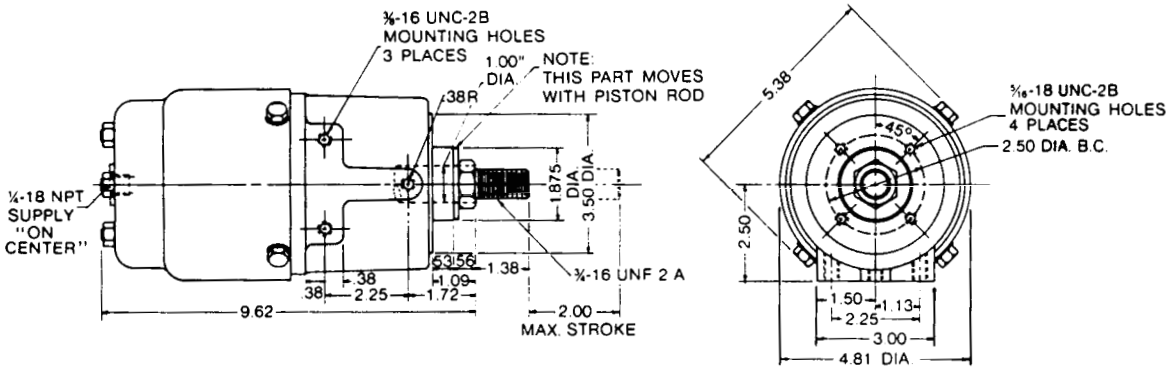


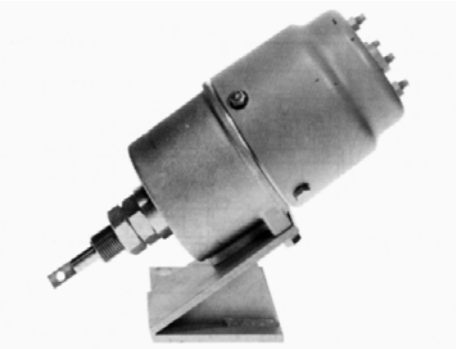
Ordering Information

Model	Part No. (Old Part No.)	Pressure Range psi (bar)	Weight lbs. (kg)
12E, 2” stroke	R431006312 (P –063910-00000)	10 - 60 (0.69-4.14)	14.4 (6.53)
12E, 2” stroke	R431006313 (P –063911-00000)	10 - 90 (0.69-6.21)	14.4 (6.53)

For service information, see service manual SM-900.4413.

The “E” Type Model 12E Diaphragm Linear Positioner is the most powerful of the diaphragm positioners. The diaphragm’s low friction and sensitive action, a relative long stroke and the constant area of a cylinder enable the “E” Type to handle heavier force positioning applications with accuracy. The 12E force rating is 4,500 inch-lb. degrees (508m-N). They can be mounted using the 3-point mountings pad or integral rabbet style mounting holes in the head.





(Part number R431007099 shown)

Application:

For control of engine speed from Idle to Full by positioning governor control arm in response to pneumatic pressure signals from a remotely located control station. Suitable for use with most diesel engines, brackets and linkage adapted for Caterpillar Tractor D398 and D399.

Features:

- Rugged construction, -40°F to 165°F (-40°C to 74°C) operating temperature range.
- Rolling diaphragm actuation for accurate positioning and sensitive, low-hysteresis control.
- Control signal range 10 to 60 psi (0.69 to 4.14 bar) idle to full.
- Output rod travel of 2 inches (50.8 mm).
- Built-in yield spring for over-travel protection of engine governor.

Operation:

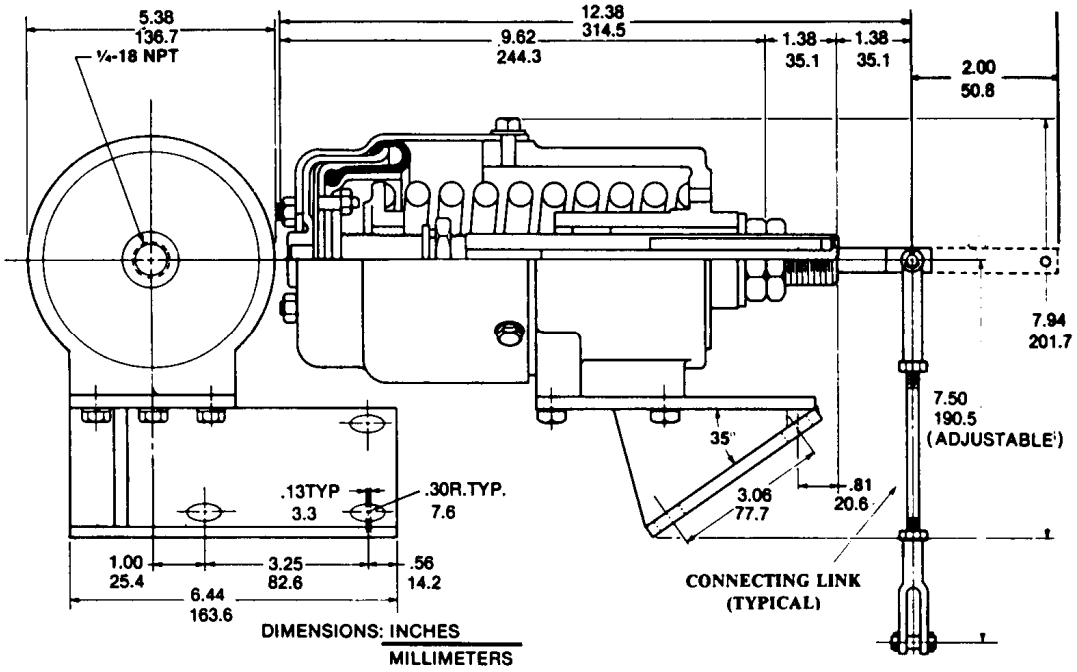
Control signal pressure applied to the diaphragm is balanced against the calibrated positioning spring to produce a specific output rod position for each increment of pressure. Positioner travel is thus proportional to pressure delivered from a remotely located pressure graduation control valve. Engine speed is therefore controlled through its operating range in proportion to the movement and position of the control valve handle at the remote operating station.

Ordering Information

Model	Part No. (Old Part No.)	Pressure Range psi (bar)	Weight lbs. (kg)
12EC, with Bracket*	R431007099 (P –067423-00000)	10 - 60 (0.69-4.14)	17 (7.71)
12EC	R431007101 (P –067424-K0000)	10 - 90 (0.69-6.21)	14.4 (6.53)
Adjustable connecting linkage kit (purchase separate)	R431007131 (P –067443-00000)		

*Adapted for Caterpillar D398 and D399 engines.

For service information, see service manual SM-900.4413



Repair Kit List

Service Manual	Description	Repair Kit Part No.
SM-900.4401	AA1 Actuator Repair Kit	R431006220 (old P –063381-00000)
	AB1 Actuator Repair Kit	R431006218 (old P –063379-00000)
	BA1 Actuator Repair Kit	R431006219 (old P –063380-00000)
	AA1 & AB1 Actuator Conversion Kit (converts old style needle bearings to new style nylon bearings)	R431006221 (old P –063382-00000)
SM-900.4407	A-2-H Actuator Repair Kit, Major	R431006212 (old P –063286-00000)
SM-900.4409	“C” Linear Positioner, Small, Repair Kit (for P-59023 & P-64713 series)	R431005657 (old P –061051-00000)
	“C” Linear Positioner, Small, Repair Kit (for R431006434)	R431006593 (old P –065291-00000)
SM-900.4408	“C” Linear Positioner, Large, Repair Kit	R431004612 (old P –058613-00000)
SM-900.4413	Type “E” Linear Positioner	See service manual
SM-900.4404	Two Direction Positioner, Cast Body Type, Repair Kit	R431006440 (old P –064454-00000)

With these repair kits, the elastomer seals and some common wear parts on the component are renewed. On severely worn or damaged components, additional parts may be required. For additional parts, information and service instructions, refer to Service Manuals listed above. Most service manuals can be downloaded from the web at www.aventics.com/us.

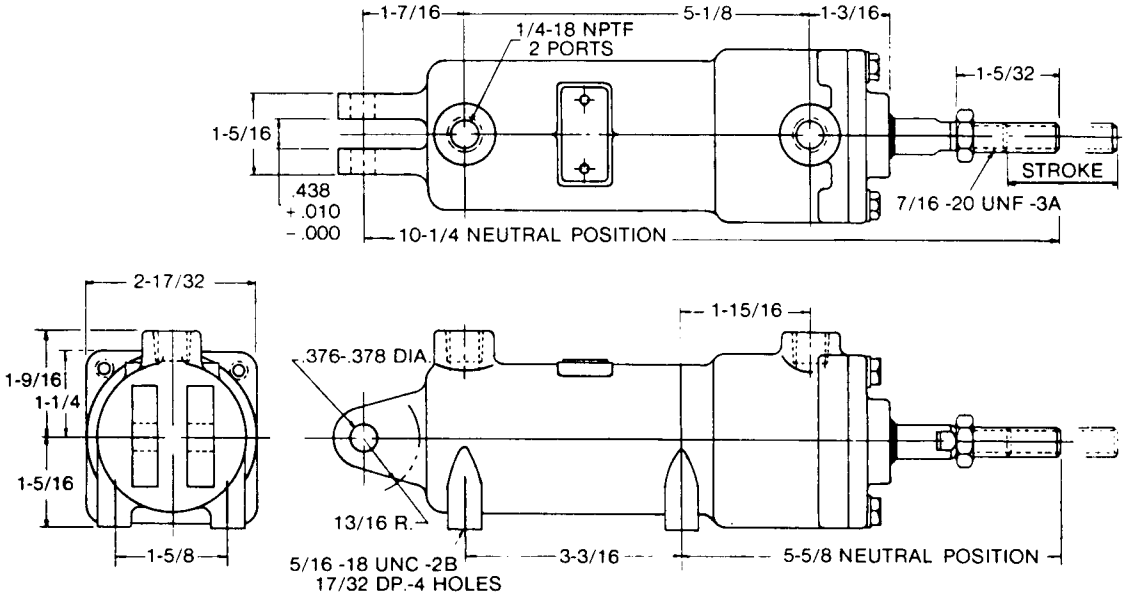
An extremely versatile type, the Two-Direction positioners move 1/2 their total stroke length in each direction from a center “zero” position. They are compact, accurate linear piston type with three total stroke lengths, 1”, 1-1/2” and 2” (25.4, 38.1 and 50.8 mm). AVENTICS HC-2 Controlair® valves or MC-2 Type M Plus™ Pressure Control valves are natural partners with the Two-Direction positioners.

Ordering Information

Part No. (Old Part No.)	Pressure Range psi (bar)	Force Rating in.lb. deg. (m-N)	Weight lbs. (kg)
R431004748 (P –058822-00500)	5 - 80 (0.34 - 5.52)	410 (46)	2.5 (1.13)
R431004749 (P –058822-00750)	5 - 115 (0.34 - 7.93)	615 (69)	2.6 (1.18)
R431005261 (P –059833-01000)	10 - 60 (0.69 - 4.14)	820 (93)	2.7 (1.2)
R431006592 (P –065289-01000)	20 - 70 (1.38 - 4.83)	820 (93)	2.7 (1.2)
R431007074 (P –064076-01000)	10 - 90 (0.69 - 6.21)	820 (93)	2.7 (1.2)

Repair kit part number: R431006440 (old P -064454-00000)

For service information, see service manual SM-900.4404



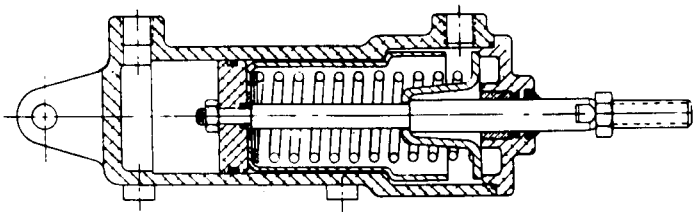
The two-direction positioner is a low-sensitivity, infinite positioning device that is controlled by a graduating control valve, such as our Type “H” Controlair® valve, Type M Plus™ Pressure Control valve or Flexair® valve as shown in the Special Duty Valves section in catalog SC-700. The positioner has a wide range of applications including positioning of 4-way hydraulic valves, over center hydraulic pumps and other low-force mechanisms. It is corrosion-resistant and constructed of lighweight, die-cast, anodized aluminum with a chrome-plated piston rod and long-wearing syntheic rubber seals.

Maximum stroke of the piston rod is one inch (25.4 mm) on each side of the center position, making a total piston rod travel of two inches (50.8 mm). External envelope dimensions of the positioner do not change.

NOTE: Control pressure should match the operating pressure of the positioner to eliminate any lost motion in the control valve.

Operation:

Maximum pressure of the two-direction positioner is 150 psi (10.34 bar) at a temperature range of –40° F to 165° F (-40° C to 74° C). The positioner is held in its center position by a coil spring caged on the piston rod. When air pressure is supplied to the cap-end port, the piston rod moves to its extended position. When pressure is supplied to the head-end port, the piston rod moves to its retracted position.



ASSEMBLY VIEW

Available Forces:

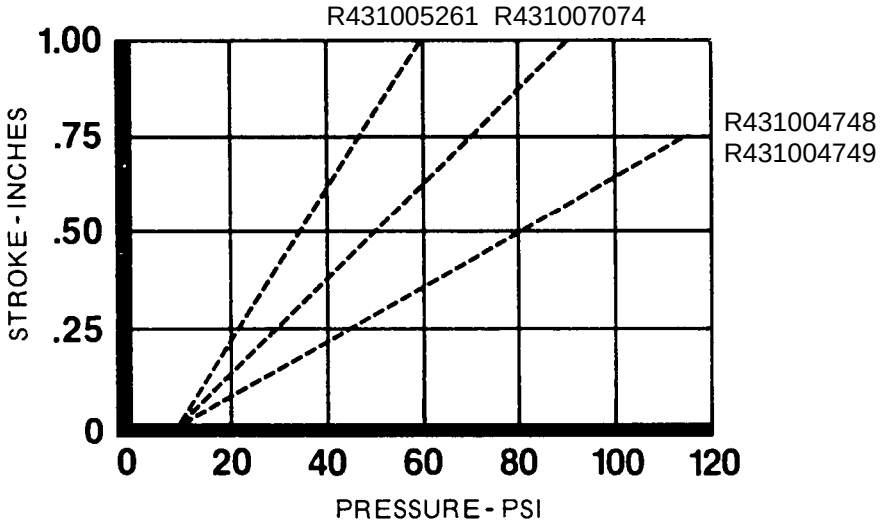
The accompanying graph shows pressure in psi required to overcome the force of the spring as the piston rod is retracted or extended from its center position. From the graph, pounds of spring force can be determined by multiplying the pressure (psi) by the piston area. The following force ratings are based on 3 psi x 2.4 square inches (piston area).

R431004748 410 in.-lb.-degrees (46 m-N) or 7 lbs. (31.1 N) through 1” (25.4 mm) travel.

R431004749 615 in.-lb.-degrees (69 m-N) or 7 lbs. (31.1 N) through 1 1/2” (38.1 mm) travel.

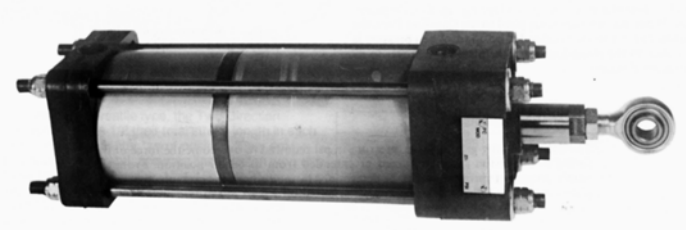
R431005261 820 in.-lb.-degrees (93 m-N) or 7 lbs. (31.1 N) through 2” (50.8 mm) travel.
(same for R431006592 and R431007074)

To determine the control valve output pressure at any piston travel for either retracted or extended strokes, project across the graph from the appropriate stroke length point on the vertical line until the pressure line is intersected. Project down fro this point to arrive at the pressure in psi. This is the no-load pressure required of the valve. Normally 3 psi (0.21 bar) above this is required to move a load of 7 lbs. (31.1N).



PISTON AREA: EXTENDED 2.4 sq. in. **(1548 sq. mm)**
RETRACTED 2.2 sq. in. **(1419 sq. mm)**

Mounting kits to mount this two-direction positioner on Sunstrand hydraulic pumps are available, see catalog SC-1000. Consult factory for recommendations for other hydraulic pump brands.



(Part number R431007074 shown)

Application:

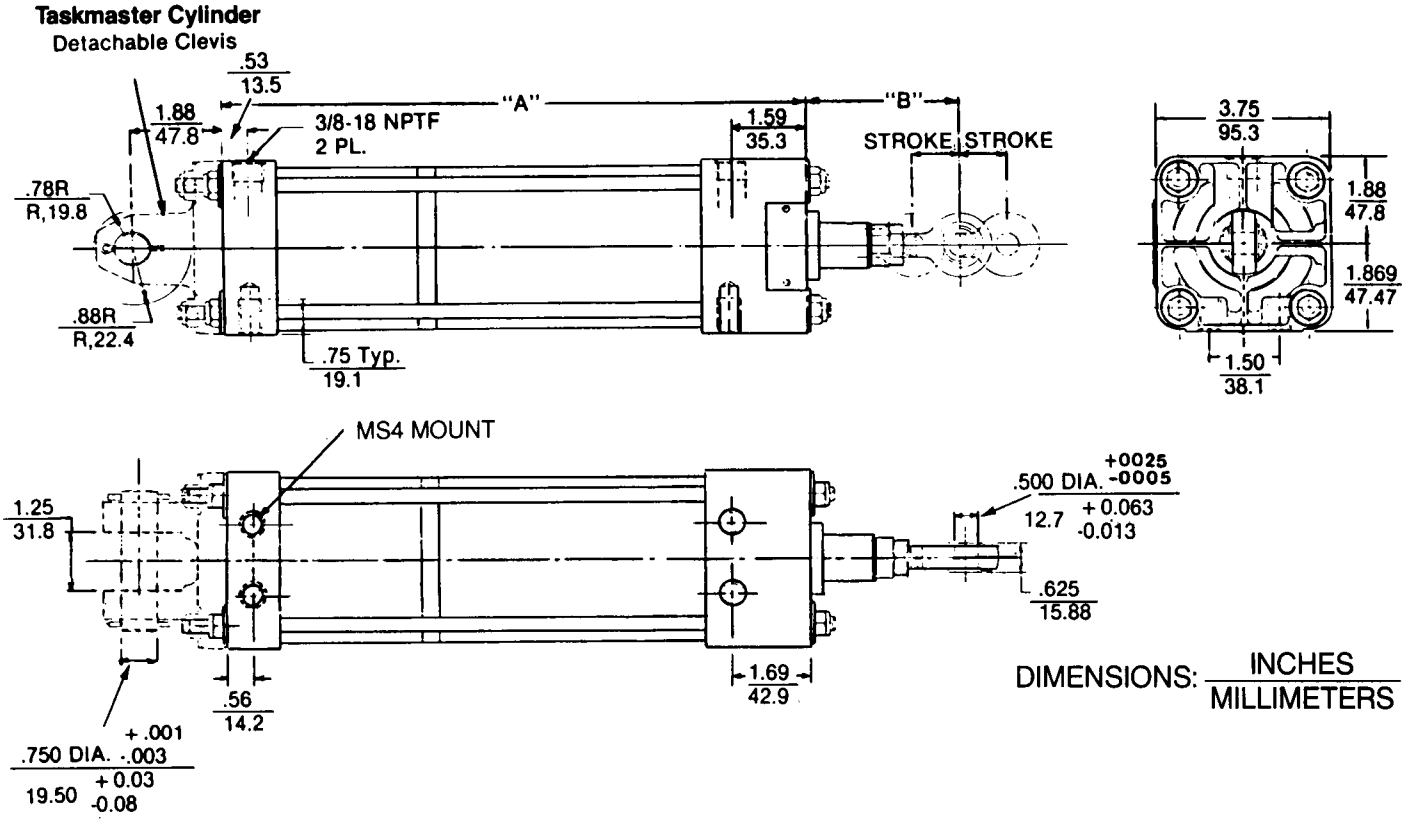
For infinite positioning control of: large hydraulic over-center pumps and motors, large hydraulic spool valves, ball and butterfly valves or other devices from a remotely located control station.

Features:

- Rugged, corrosion resistant construction
- Accurate, low-hysteresis positioning
- Selection of 1”, 2” or 3” (25.4, 50.8 or 76.2 mm) of stroke either side of center
- Spherical bearing rod eye standard
- Integral MS4 blind tapped hole mounting (other 3 1/4” TaskMaster® cylinder mounting kits adaptable)
- Control signal range 10 to 90 psi (0.69 to 6.21 bar), center to full extend or retract position
- Fully caged positioning spring allows easy, safe disassembly for servicing or installation of mounting kits with extended tie rods.

Operation:

A graduated pressure control signal is applied to one side of the positioner piston and resulting force is balanced against the calibrated positioning spring to produce a specific output rod position for each increment of pressure. Piston rod travel in either direction is thus proportional to pressure delivered from a remote pressure graduation control valve. The controlled device therefore is positioned through its operating range in accordance with the position and direction selected for the remote control valve handle.



Ordering Information

Part No. (Old Part No.)	Pressure Range psi (bar)	Optimum Force Rating based on total travel	Stroke (each side of ctr.)	"A" Dim. In. (mm)	"B" Dim. In. (mm)	Weight lbs. (kg)
R431007074 (P –067406-01000)	10 - 90 (0.69 - 6.21)	25 lbs. thru 2"/5.08 or 1620 in.-lb. deg (183 m-N)	1.00 (25.4)	11.25 (285.8)	3.25 (82.6)	6.8 (3.08)
R431007075 (P –067406-02000)	10 - 90 (0.69 - 6.21)	25 lbs. thru 4"/10.16 or 3240 in.-lb. deg (366 m-N)	2.00 (50.8)	16.12 (409.4)	4.25 (108.0)	7.8 (3.54)
R431007076 (P –067406-03000)	10 - 90 (0.69 - 6.21)	25 lbs. thru 6"/15.24 or 4860 in.-lb. deg (549 m-N)	3.00 (76.2)	21.00 (533.4)	5.25 (133.4)	8.8 (3.99)

For service information, see service manual SM-900.4404.

How to Order:

1. Determine positioning requirements (force and length of travel, or degrees of rotation and level arm radius).
2. Select Two-Direction Positioner from above chart that equals, or exceeds, required stroke and provides adequate force/hysteresis trade-off.
3. Select appropriate TaskMaster® Cylinder Mounting Kit if desired. TaskMaster mounts MP2, MP4, MF2, MT2, MS2 and integral MS4 are suitable - see catalog SC-200 for details.
4. Select appropriate pressure graduating control valve such as AVENTICS HC-2 ControlAir®, MC-2 M PLUS™ Pressure Control Valve or Flexair® to suit application.
5. Adjust linkage to use the full stroke of the positioner, and adjust valve output (under rated load) to use full handle travel to match full positioner stroke for maximum sensitivity and "feel".

CONSTRUCTION GRADE (CAST IRON) AIR CYLINDERS
Air to 120 psi Cast Iron Body Construction
2 1/2" thru 4 1/2" bore Double Acting
Spring Returned Models
Fixed & Limited Stroke Availability

MULTI-POSITION AIR CYLINDERS
Air to 150 psi
2, 3, 4, 5, 6, 7, & 8 Position Models
Fixed Stroke Increments– Limited Mountings
Cast Body Construction

Note: Most service manuals can be downloaded from the web at: www.aventics.com/us

Specifications:

Operating pressure:	120 psi (8.27 bar) max.
Temperature range:	-20° F to 160°F (-29° C to 71° C) 200° F (93° C) intermittently
Ports:	1/4” or 3/8” NPTF
Mounting:	integral female clevis

Construction grade (cast iron) cylinders are heavy-duty cylinders specially designed to meet your most severe applications.

Constructed of unyielding semi-steel, these durable cylinders are unequalled for clutch, brake and other medium-duty cycle applications. With their many dependability-plus features, you can be sure of long, reliable service.

Efficient Design… Efficient design keeps down-time to an absolute minimum.

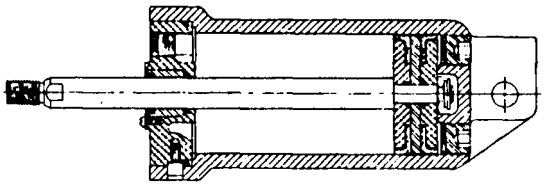
Resists External Damage...Protection against dents is assured by the semi-steel body. Further rigidity is provided by the one-piece design of the body, cap and swivel mount. Damaging dirt is filtered by a metal strainer in the non-pressure port.

Easily Maintained...Grease lubricated at the factory before it comes to you. Maintenance-free service is prolonged because of the grease-retaining qualities of the semi-steel body.

All parts of the cylinder are accessible by disconnecting the rod end and removing only four screws. The entire internal assembly easily slides out as one unit. It is seldom necessary to remove the cylinder from its mounting.

External replacement of the rod bearing, seal and wiper is fast and simple (model with integral rod and rod eye requires routine disassembly).

Built to Last...Resistance to wear and corrosion is engineered into all parts of the cylinder, and its life and appearance are enhanced b the non-corrosive qualities of the semi-steel body. Long-wearing rod bearings are either brass or sintered bronze. The piston rod is hard-chrome plated steel. Other corrosive-resistant parts include an anodized aluminum head, piston and follower. To assure positive seal with minimal friction, only genuine AVENTICS Packing Cups are used.



Assembly View

Ordering Information

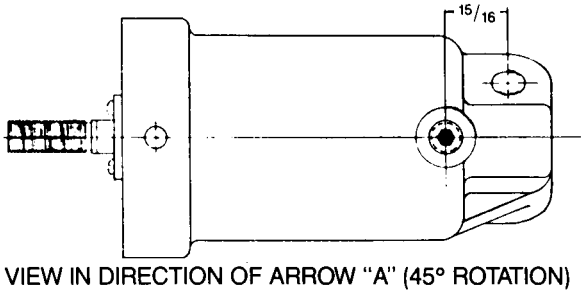
Cylinder Part No.		BORE	STROKE	MODEL	Description	Spring Force (lbs.)		Weight lbs. (kg)	Ref. No.
Part No.	Old Part No.					At "0" Stroke	Increase Per Inch of Stroke		
R431003154	P -053341-00000	2-1/2"	4"	DA	- - - - - - - - - - - - -	--	--	9 (4.1)	1
R431003155	P -053342-00000	2-3/4"	2-3/4"	SA	Push - Spring Returned	10	8.0	9 (4.1)	2
R431003157	P -053343-00000	2-3/4"	2-3/4"	SA	Push - Spring Returned	10	8.0	9 (4.1)	2
R431003405	P -054640-00000	2-3/4"	2-3/4"	SA	Push - Spring Returned	23	9.18	9 (4.1)	3
R431003406	P -054640-00001	2-3/4"	2-3/4"	SA	Pull - Spring Extended	23	9.18	9 (4.1)	3
R431003158	P -053344-00000	2-3/4"	3"	DA	- - - - - - - - - - - - -	--	--	9 (4.1)	2
R431003797	P -055521-00001	2-3/4"	3"	DA	- - - - - - - - - - - - -	--	--	9 (4.1)	4
R431003327	P -054176-00002	3-1/2"	2-7/8"	SA	Push - Spring Returned	40	20.0	12 (5.4)	5
R431003908	P -055701-00001	3-1/2"	2-7/8"	SA	Push - Spring Returned	40	20.0	12 (5.4)	6
R431003195	P -053373-00001	3-1/2"	3-3/8"	DA	- - - - - - - - - - - - -	--	--	10 (4.5)	7
R431003160	P -053345-00002	4-1/2"	2-3/4"	SA		60	16.0	15 (6.8)	8
R431003159	P -053345-00000	4-1/2"	3-1/4"	SA	Push - Spring Returned	40	16.0	15 (6.8)	8
R431003161	P -053346-00000	4-1/2"	3-1/4"	SA	Push - Spring Returned	40	16.0	15 (6.8)	8
R431003723	P -055433-00000	4-1/2"	3-3/16"	DA	- - - - - - - - - - - - -	--	--	15 (6.8)	8
R431003724	P -055433-00001	4-1/2"	3-3/16"	DA	- - - - - - - - - - - - -	--	--	15 (6.8)	8

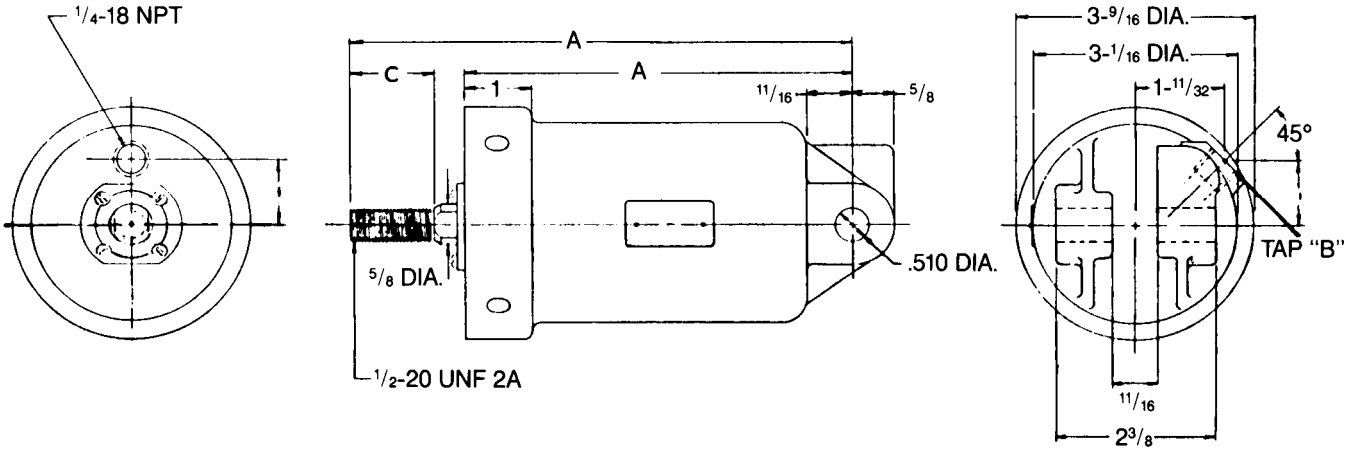
SA = Single Acting DA = Double Acting

Outline Dimensions

Reference 1: Part no. R431003154

Part No.	A in. (mm)	B in. (mm)	C in. (mm)
R431003154	10 (254.0)	7 1/8 (181.0)	3/4 (19.1)



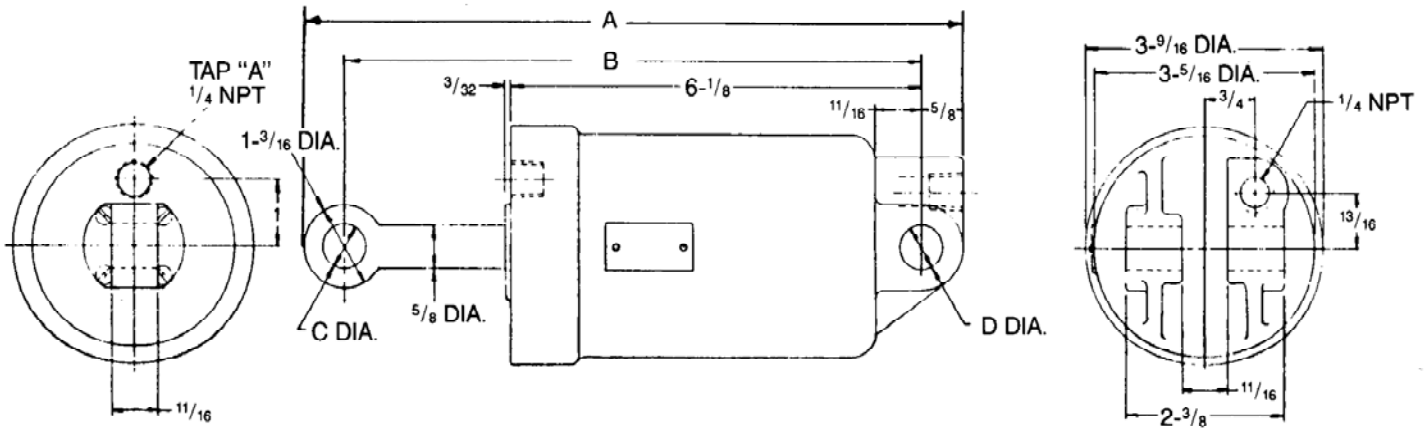


Reference 2: Part no. R431003155, R431003157, R431003158

Part No.	A in. (mm)	B in. (mm)	C in. (mm)	D in. (mm)	Remarks
R431003155*	8-9/32 (261.1)	7-1/16 (179.4)	0.510 (13.0)	0.510 (13.0)	Filter Plug Tap "A"
R431003157†	8-1/2 (215.9)	n/a	n/a	0.510 (13.0)	Filter Plug Tap "A", no rod eye
R431003158	9-27/32 (250.0)	8-5/8 (219.1)	0.635 (16.1)	0.635 (16.1)	

* Tap "A" rotated 180° from illustration

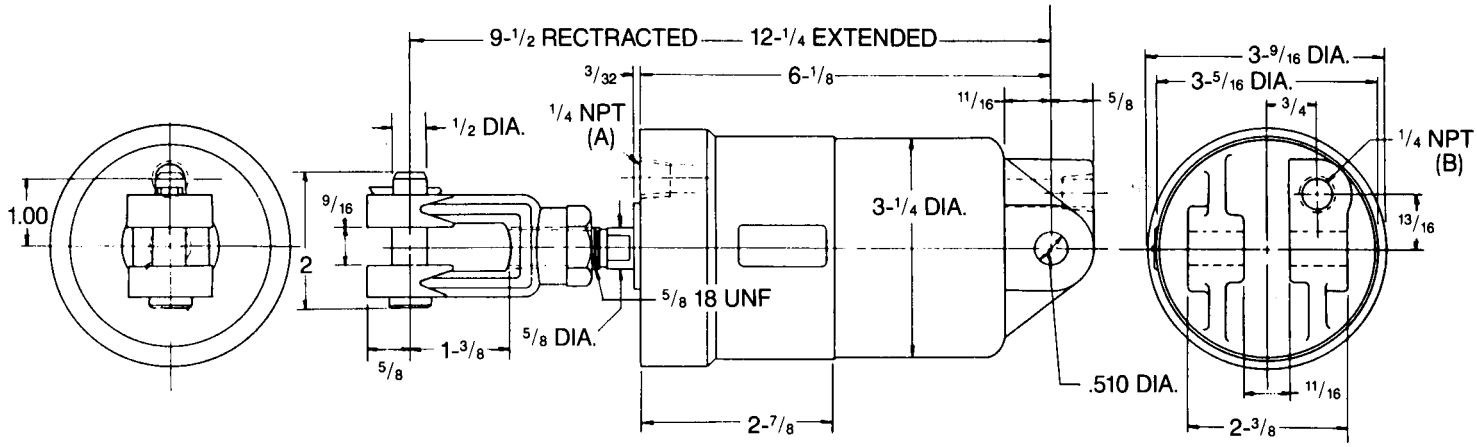
† Male rod end: 5/8"-18 UNC-2 thread, 1-1/8" (28.6mm) in length.



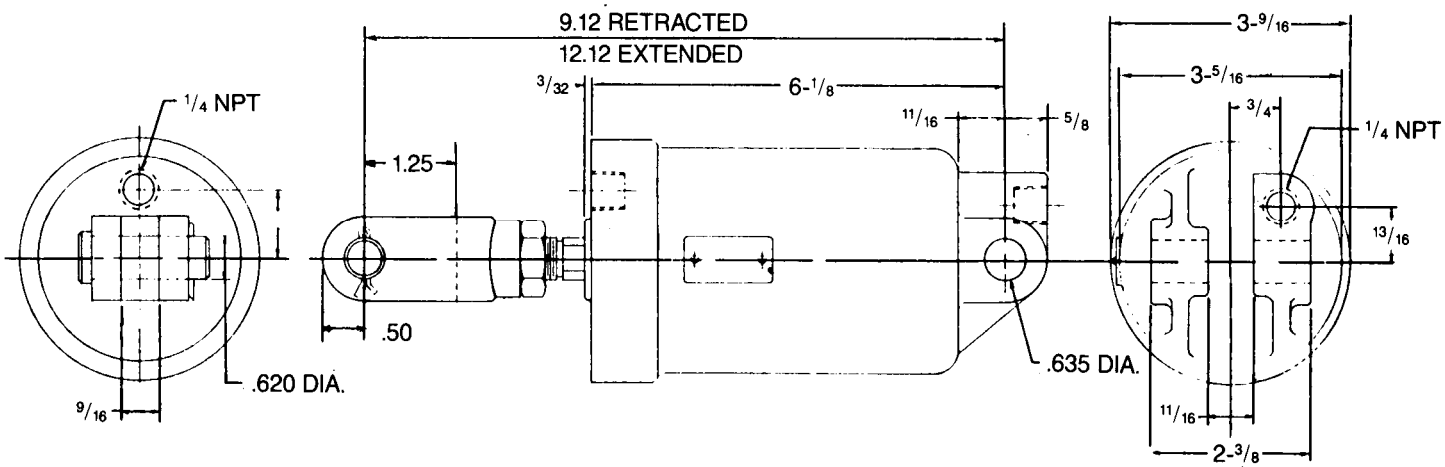
Outline Dimensions

Reference 3: Part no. R431003405 & R431003406

Part No.	Type	Remarks
R431003405	Spring Retracted	Filter Plug Tap “A”
R431003406	Spring Extended	Filter Plug Tap “B”

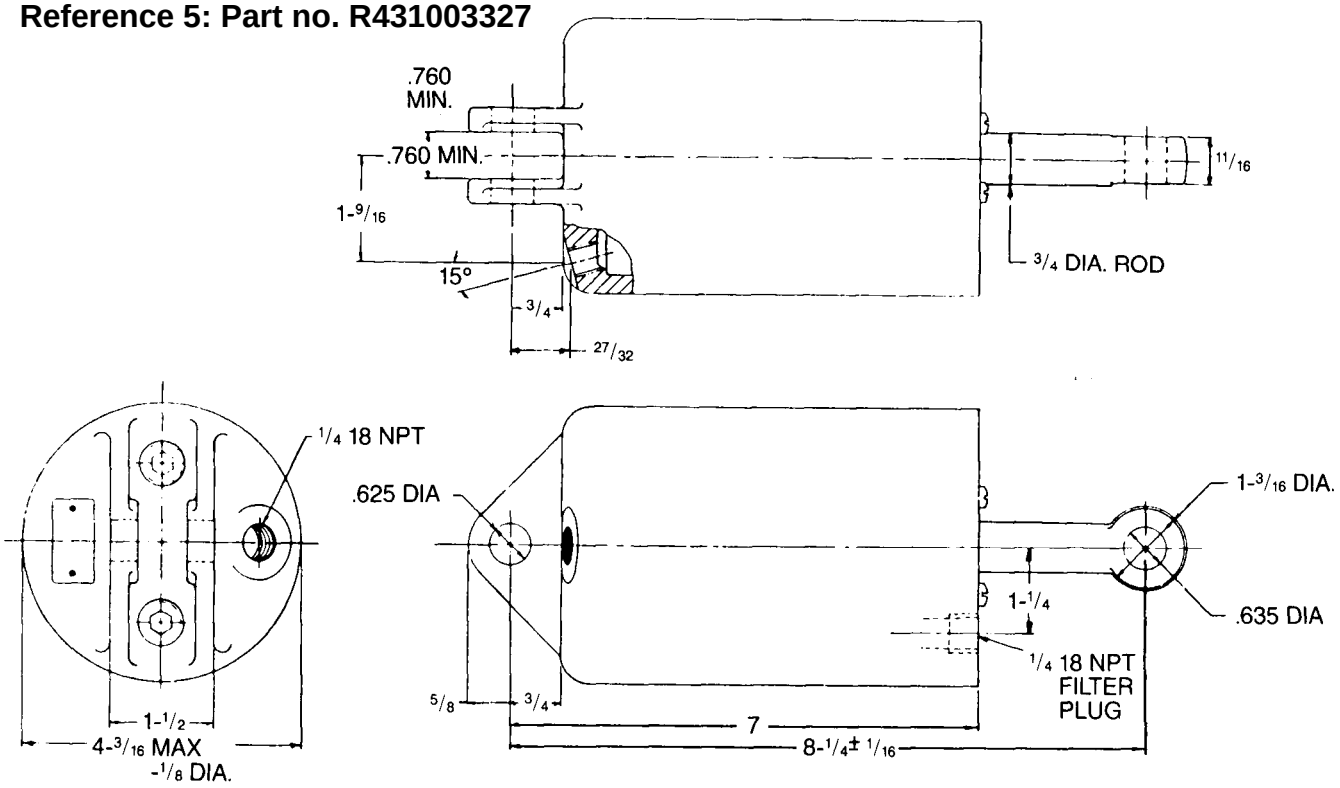


Reference 4: Part no. R431003797

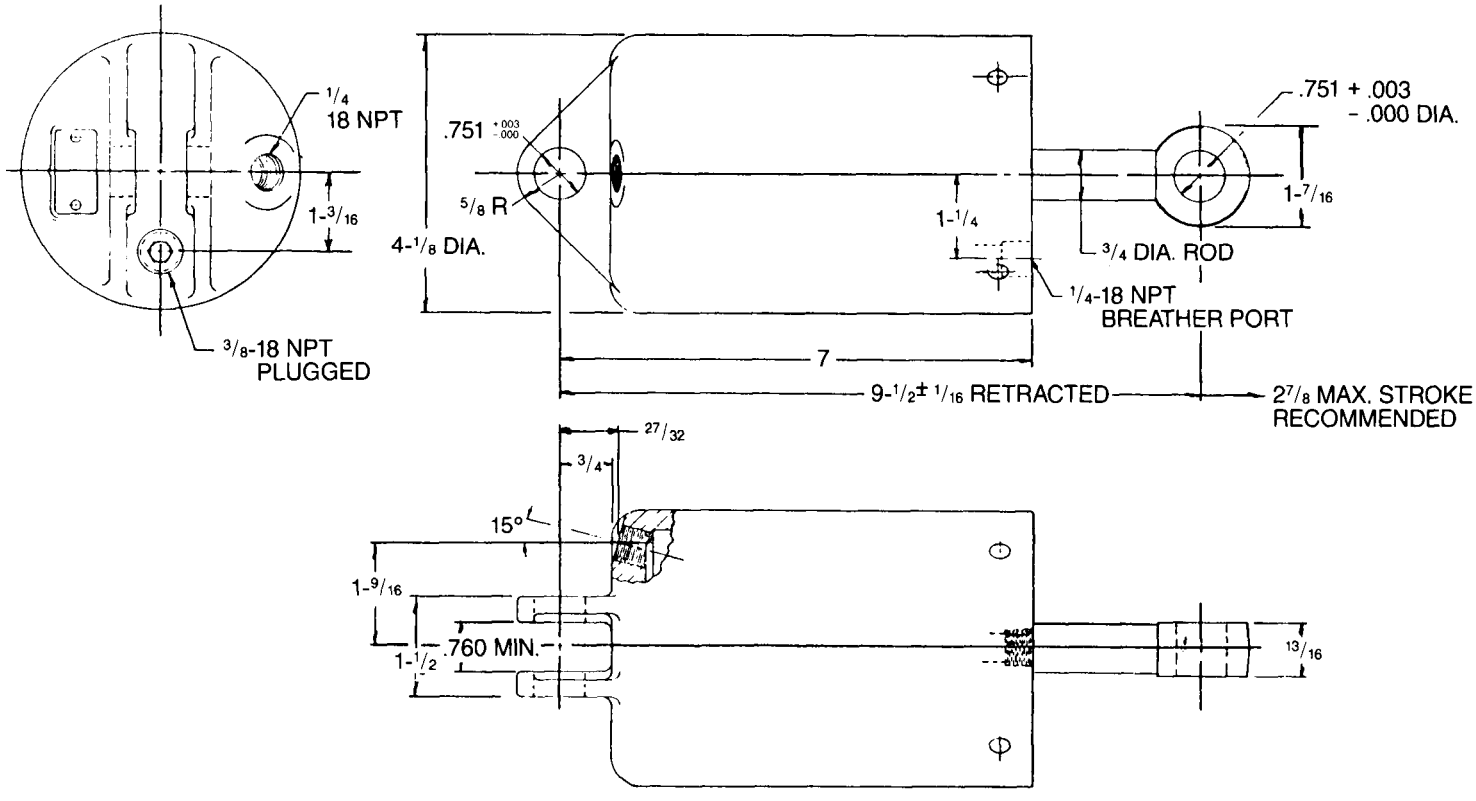


Outline Dimensions

Reference 5: Part no. R431003327

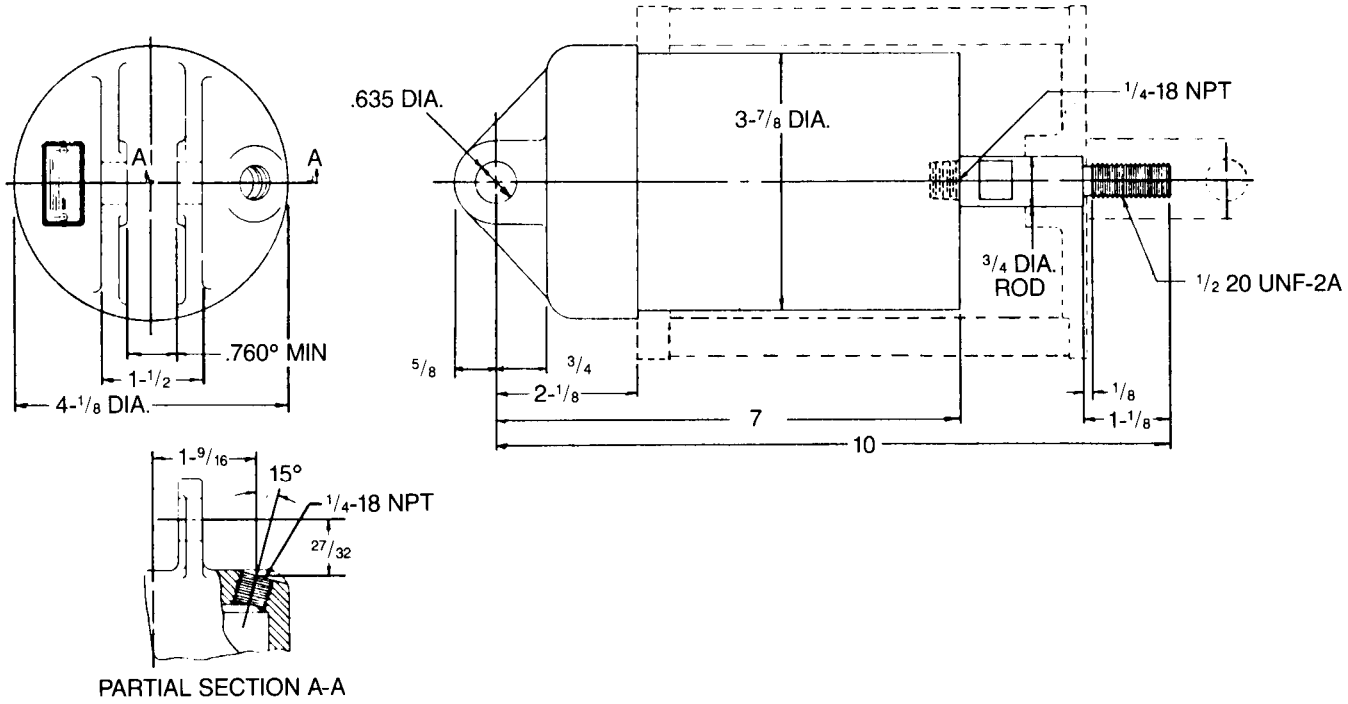


Reference 6: Part no. R431003908



Outline Dimensions

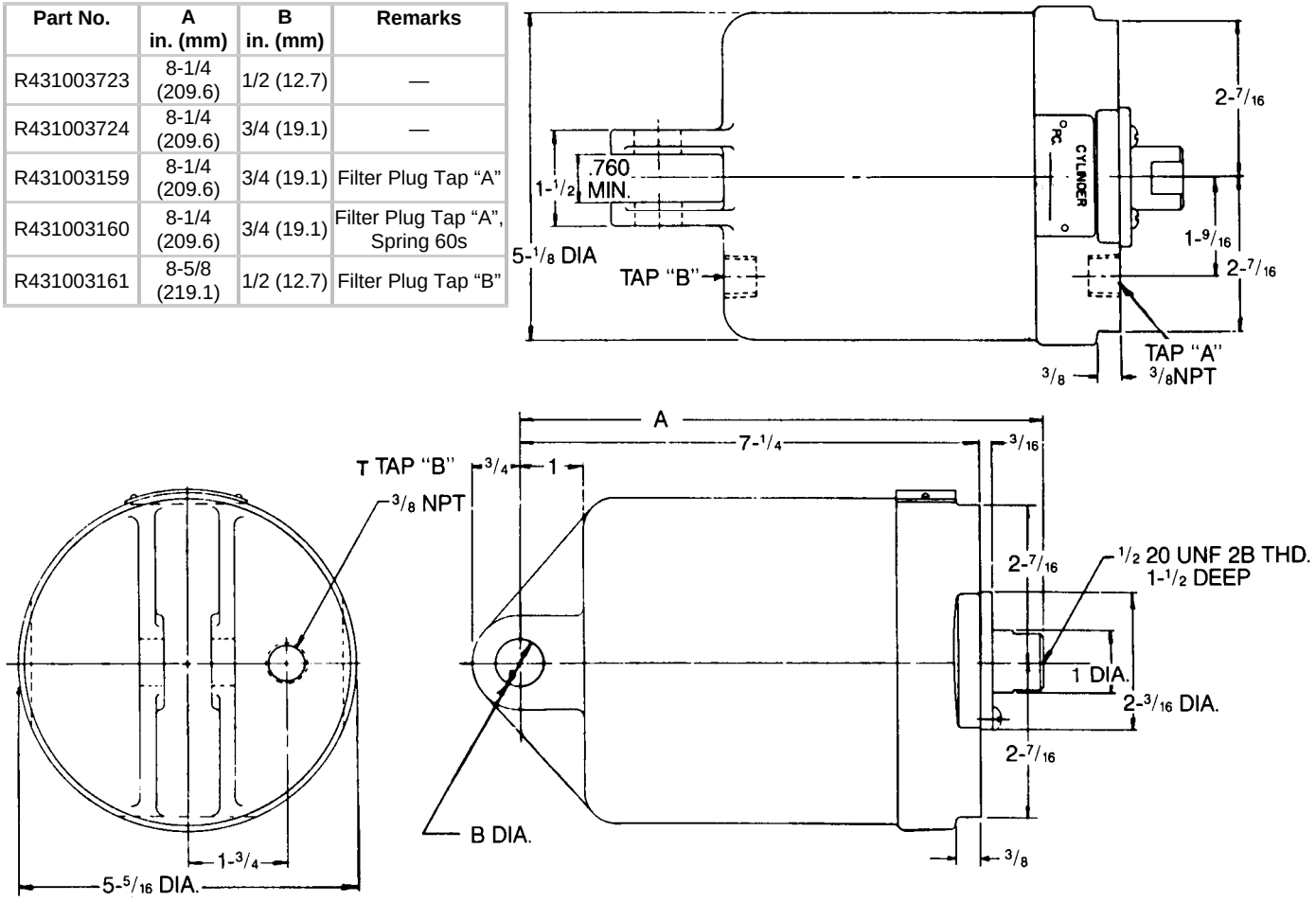
Reference 7: Part no. R431003195



Outline Dimensions

Reference 8: Part no. R431003723, R431003724, R431003159, R431003160 & R431003161

Part No.	A in. (mm)	B in. (mm)	Remarks
R431003723	8-1/4 (209.6)	1/2 (12.7)	—
R431003724	8-1/4 (209.6)	3/4 (19.1)	—
R431003159	8-1/4 (209.6)	3/4 (19.1)	Filter Plug Tap “A”
R431003160	8-1/4 (209.6)	3/4 (19.1)	Filter Plug Tap “A”, Spring 60s
R431003161	8-5/8 (219.1)	1/2 (12.7)	Filter Plug Tap “B”



Repair Kit List

Cylinder Part No.		Repair Kits	
Part No.	**Old Part No.**	**Part No.**	**Old Part No.**
R431003154	P -053341-00000	R431004928	P -059161-00000
R431003155	P -053342-00000	R431004930	P -059163-00000
R431003157	P -053343-00000	R431004930	P -059163-00000
R431003158	P -053344-00000	R431004931	P -059164-00000
R431003159	P -053345-00000	R431004934	P -059167-00000
R431003160	P -053345-00002	R431004934	P -059167-00000
R431003161	P -053346-00000	R431004935	P -059168-00000
R431003195	P -053373-00001	R431004933	P -059166-00000
Obsolete	P -054172-00000	R431004928	P -059161-00000
R431003327	P -054176-00002	R431004932	P -059165-00000
Obsolete	P -054190-00001	R431003316	P -059169-00000
Obsolete	P -054190-00002	R431003316	P -059169-00000
Obsolete	P -054198-00000	R431004929	P -059162-00000
R431003405	P -054640-00000	R431004930	P -059163-00000
R431003406	P -054640-00001	R431004931	P -059164-00000
R431003723	P -055433-00000	R431004935	P -059168-00000
R431003724	P -055433-00001	R431004935	P -059168-00000
R431003797	P -055521-00001	R431004931	P -059164-00000
R431003908	P -055701-00001	R431004932	P -059165-00000
Obsolete	P -057530-00000	R431004928	P -059161-00000

With these repair kits, the elastomer seals and some common wear parts on the component are renewed. On severely worn or damaged components, additional parts may be required. For additional parts, information and service instructions, refer to Service Manual SM-1000-4200.

This and other service manuals can be downloaded from the web at www.aventics.com/us.

Specifications:

Operating pressure:	150 psi (10.3 bar) max.
Temperature range:	-40° F to 180°F (-40° C to 82° C)
Ports:	1/4" NPTF
Mounting:	integral female clevis

The two-position cylinder is a positioning device controlled by a three-way (single-acting model) or a four-way (double acting model), two-position, control valve such as the "A" or "D" Pilotair® valves. The cylinder has a wide range of applications, being particularly suited for shifting transmissions and positioning hydraulic valves. It is corrosion-resistant and constructed of lightweight, die-cast, anodized aluminum heads, pistons and body.

Cylinders with return springs can be used for infinite positioning, similar to an actuator, by selecting the proper graduating pressure control valve (see catalog SC-800 for H Controlair® and Flexair® valves). To select the required pressure range of the control valve, see the graph shown under "available Forces" on the following page.

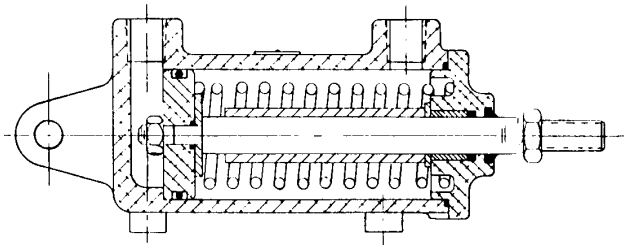
Maximum stroke of the piston rod for each cylinder is shown, with shorter strokes available in 1/16" (1.6mm) increments only. External envelope dimensions of the cylinder do not change. The complete model number (same as old part number) for the cylinder and the piston stop will have an identical five-digit suffix. The first digit is always zero; the last four digits show the stroke in thousandths of an inch.

Installation & Adjustment
Because cylinders are installed at the end of an air system, they are vulnerable to dirt and moisture carried through the air lines. Therefore, before installing the two-position cylinder, all air lines in the system should be blown clean. It is recommended that the cylinder be mounted with the ports facing down. Gravity can then assist in preventing foreign material from accumulating in the cylinder by removing it through the control valve exhaust.

In providing a mounting for the cylinder, an adjustable link must be included between the piston rod and the lever to which the rod is connected.

Operation
Maximum operating pressure of the two-position cylinder is 150 psi (10.3 bar) at a temperature range of –40° F to 180° F(-40° C to 82° C). On the single-acting model, supply pressure from a three-way control valve is piped through the cap-end port to move the piston rod to its extended position. When air pressure is exhausted, a spring returns the piston rod to its retracted position.

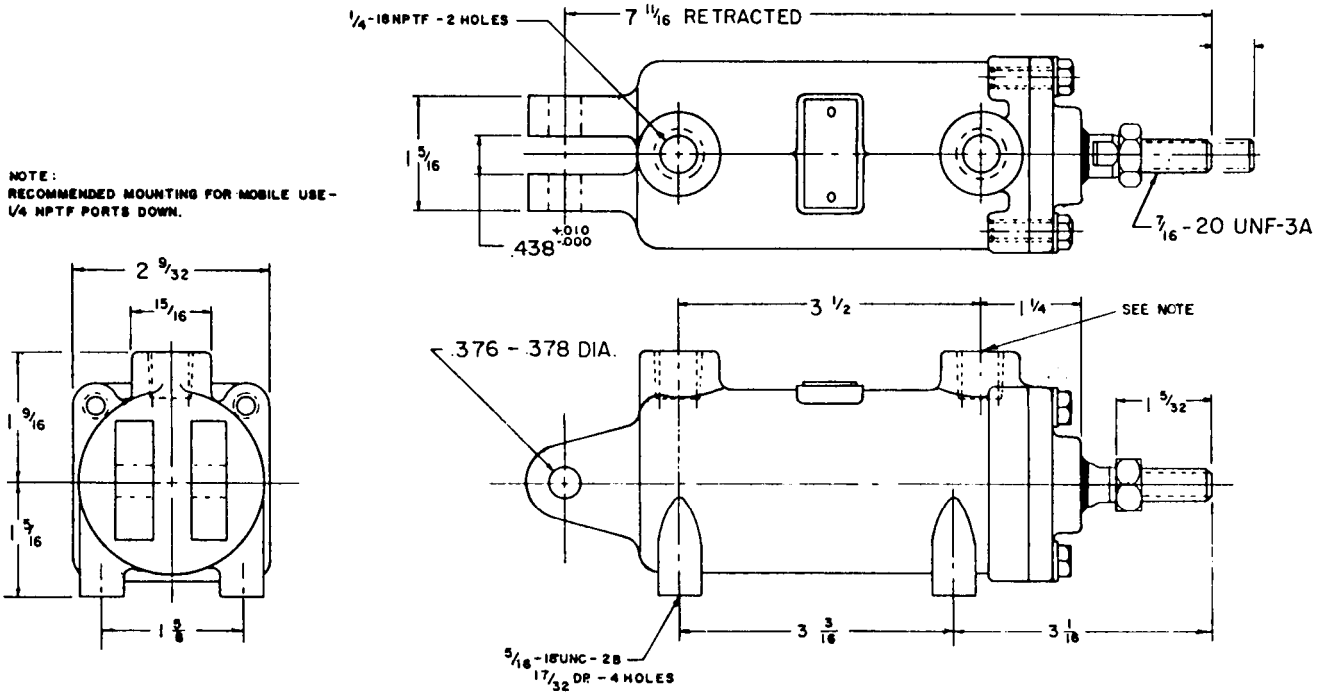
On the double-acting model, the return spring is ommitted, and a four-way control valve is used. Pressure supplied to either the cap-end or head-end port will force the piston rod to its extended or retracted position, respectively.



Assembly View
(Single-Acting Model)

Maintenance
Periodically disassemble the cylinder for cleaning, inspection and lubrication. Clean all metal parts with a nonflammable solvent, and wash all rubber parts with soap and water. Rinse thoroughly and blow dry with a low-pressure air jet. Replace those part which are damaged or worn.

Reassemble the cylinder, using the exploded and assembly views as reference. No special tools are required. To avoid cutting or nicking the piston O-ring, carefully insert the piston rod assembly into the cylinder bore with the piston tilted at a slight angle. As the assembly proceeds, lubricate all O-rings with Dow Corning 55M grease.



REFER TO AVAILABLE FORCE RATING ON NEXT PAGE

Part No.	Old Part No./ Model Code	Type of Operation	Effective Stroke in. (mm)
R431004025	P -057368-00500	Single Acting, Spring Returned	1/2 (12.7)
R431004026	P -057368-01000	Single Acting, Spring Returned	1 (25.4)
R431004027	P -057368-01125	Single Acting, Spring Returned	1-1/8 (28.6)
R431004874	P -058994-01500	Single Acting, Spring Returned	1-1/2 (38.1)
R431004875	P -058994-01812	Single Acting, Spring Returned	1-13/16 (46.0)
R431004876	P -058994-01875	Single Acting, Spring Returned	1-7/8 (47.6)
R431006041	P -062303-02125	Single Acting, Spring Returned	2-1/8 (54.0)
R431006042	P -062303-02250	Single Acting, Spring Returned	2-1/4 (57.2)
R434001974	P -057401-00625	Double Acting	5/8 (15.9)
R431004122	P -057401-00812	Double Acting	13/16 (20.6)
R431004123	P -057401-00875	Double Acting	7/8 (22.2)
R431004124	P -057401-01625	Double Acting	1-5/8 (41.3)
R431004125	P -057401-01875	Double Acting	1-7/8 (47.6)
R431004126	P -057401-02500	Double Acting	2-1/2 (63.5)
R431004127	P -057401-02562	Double Acting	2-9/16 (65.1)

Note: Last four digits in the suffix of the model code/old part number denotes effective stroke in thousandths of an inch.

Repair kit part number: R431005248 (old P –059818-00000). With this repair kit, the elastomer seals and some common wear parts on the component are renewed. On severely worn or damaged components, additional parts may be required. For additional parts, information and service instructions, refer to Service Manual SM-1000-43.

Available Forces:

Force developed by the double-acting cylinder is determined by multiplying the applied air pressure by the exposed piston area.

Pounds of force (retracted stroke) = applied pressure (psi) x 2.2 square inches
Pounds of force (extended stroke) - applied pressure (psi) x 2.4 square inches

On either of the two single-acting, spring-returned models, spring force must be considered in determining force developed by the cylinder at different points in the stroke. On extended stroke:

Pounds of force = applied pressure (psi) x 2.4 square inches minus pounds of spring force

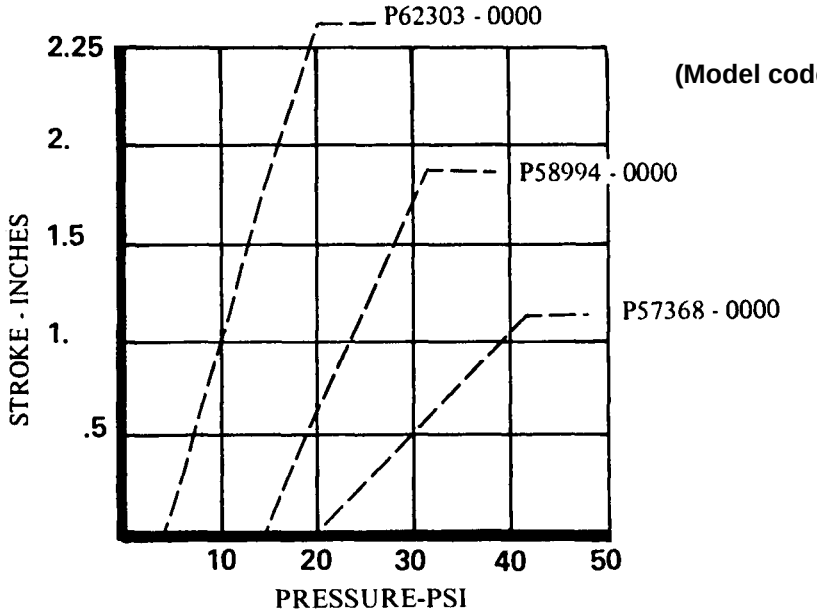
The accompanying graph shows pressure in psi required to overcome the force of the spring as the piston rod is extended. Opposing spring force increases as the stroke length of the piston rod increases and the spring is further compressed. From the graph, pounds of spring force can be determined by multiplying the pressure (psi) by the piston area. Thus, the initial force of the cylinder at zero stroke is:

Pounds of force (model codes P –057368…) = applied pressure (psi) x 2.4 square inches minus (20 psi x 2.4 square inches)

Pounds of force (model codes P –058994…) = applied pressure (psi) x 2.4 square inches minus (16 psi x 2.4 square inches)

For spring force at subsequent piston rod positions on extended stroke, project across the graph from the appropriate stroke length point on the vertical line until the pressure line is intersected. Project down from this point to arrive at pressure in psi. Multiply this figure by the 2.4 square inches of piston area.

On retracted stroke, only spring force is available.



PISTON AREA: EXTENDING = 2.4 square inches **(1548 sq. mm)**
RETRACTING = 2.2 square inches **(1419 sq. mm)**

Specifications:

Operating pressure:	150 psi (10.3 bar) max.
Temperature range:	-40° F to 180°F (-40° C to 82° C)
Ports:	1/4" NPTF
Mounting:	integral female clevis

The three-position cylinder is a positioning device controlled by a four-way, three-position, open-center control valve such as the "A" or "D" Pilotair® valves. The cylinder has a wide range of applications, being particularly suited for shifting transmissions and positioning hydraulic valves. It is corrosion-resistant and constructed of lightweight, die-cast, anodized aluminum heads, pistons and body.

Maximum stroke of the piston rod for each cylinder is 13/16" (20.6mm) on each side of the center position, making a total piston rod travel of 1 5/8" (41.3mm). External envelope dimensions of the cylinder do not change, but shorter strokes are available. The complete model number (same as old part number) for the cylinder and the piston stop will have an identical five-digit suffix. The first digit is always zero; the last four digits show the stroke in thousandths of an inch.

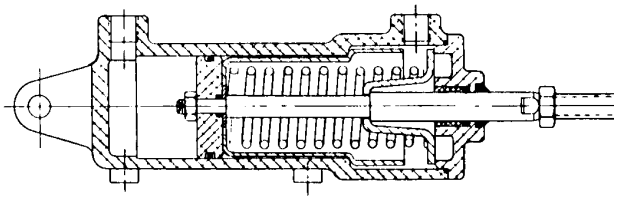
Installation & Adjustment
Because cylinders are installed at the end of an air system, they are vulnerable to dirt and moisture carried through the air lines. Therefore, before installing the three-position cylinder, all air lines in the system should be blown clean. It is recommended that the cylinder be mounted with the ports facing down. Gravity can then assist in preventing foreign material from accumulating in the cylinder by removing it through the control valve exhaust.

In providing a mounting for the cylinder, an adjustable link must be included between the piston rod and the lever to which the rod is connected. The cylinder stroke should be checked in its center position when aligned with the lever to be operated. Check for exact register, making sure the clevis pin is free from load in the center position.

This procedure will allow any inaccuracies in leverage ratio or manufacturing tolerance to be absorbed at the extremes of the stroke where exact registration is of least importance. Also, any inaccuracies will be divided between the extreme positions. When alignment is done at one of the extreme positions, inaccuracies are all in the same direction.

Operation
Maximum operating pressure of the two-position cylinder is 150 psi (10.3 bar) at a temperature range of –40° F to 180° F(-40° C to 82° C). On the single-acting model, supply pressure from a three-way control valve is piped through the cap-end port to move the piston rod to its extended position. When air pressure is exhausted, a spring returns the piston rod to its retracted position.

On the double-acting model, the return spring is omitted, and a four-way control valve is used. Pressure supplied to either the cap-end or head-end port will force the piston rod to its extended or retracted position, respectively.

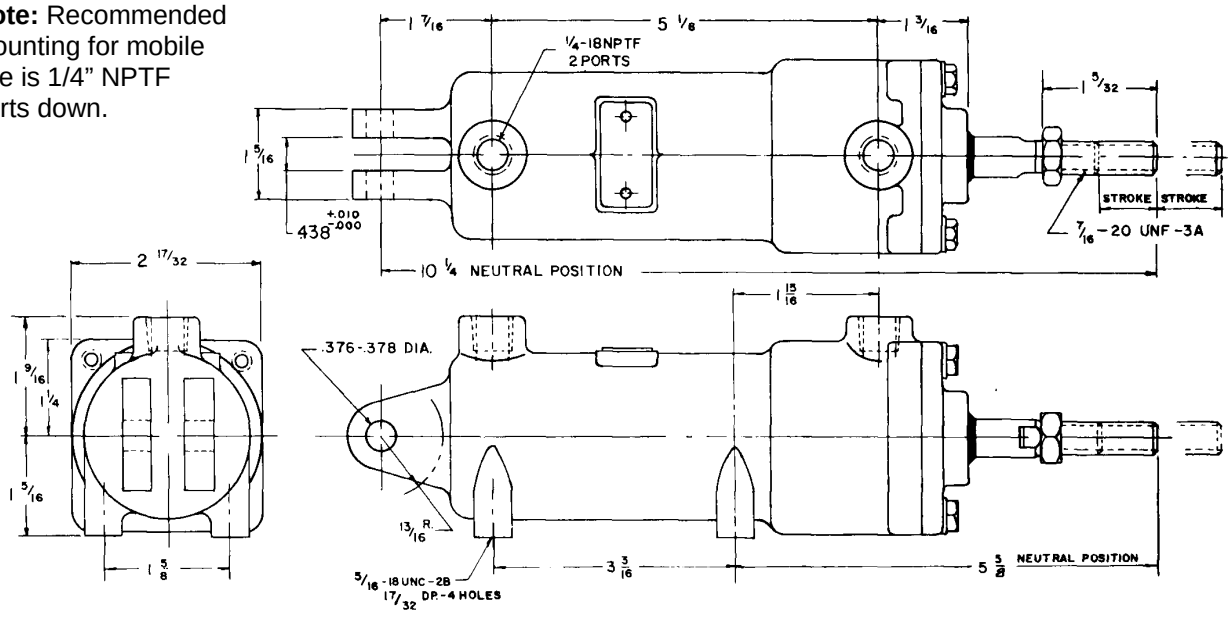


Assembly View

Maintenance
Periodically disassemble the cylinder for cleaning, inspection and lubrication. Clean all metal parts with a nonflammable solvent, and wash all rubber parts with soap and water. Rinse thoroughly and blow dry with a low-pressure air jet. Replace those part which are damaged or worn.

Reassemble the cylinder, using the exploded and assembly views as reference. No special tools are required. To avoid cutting or nicking the piston O-ring, carefully insert the piston rod assembly into the cylinder bore with the piston tilted at a slight angle. As the assembly proceeds, lubricate all O-rings with Dow Corning 55M grease.

Note: Recommended mounting for mobile use is 1/4" NPTF ports down.



Refer to Available Force Rating on next page

Ordering Information		
Part No.	**Old Part No./ Model Code**	**Stroke (each side of center) in. (mm)**
R431004052	P -057378-00312	5/16 (7.9)
R431004053	P -057378-00375	3/8 (9.5)
R431004054	P -057378-00438	7/16 (11.1)
R431004055	P -057378-00500	1/2 (12.7)
R431004056	P -057378-00625	5/8 (15.9)
R431004057	P -057378-00688	11/16 (17.5)
R431004058	P -057378-00750	3/4 (19.1)
R431004059	P -057378-00875	7/8 (22.2)
R431004060	P -057378-01000	1 (25.4)
R431004943	P -059211-00000	1-1/16 (27.0)

Note: Last four digits in the suffix of the model code/old part number denotes effective stroke in thousandths of an inch.

Repair kit part number: R431005249 (old P –059819-00000). With this repair kit, the elastomer seals and some common wear parts on the component are renewed. On severely worn or damaged components, additional parts may be required. For additional parts, information and service instructions, refer to Service Manual SM-1000-4916.

Available Forces:

Force developed by the cylinders are determined by multiplying the applied air pressure by the exposed piston area, less the spring force.

Pounds of force (retracted stroke) = applied pressure (psi) x piston area
minus pounds of spring force

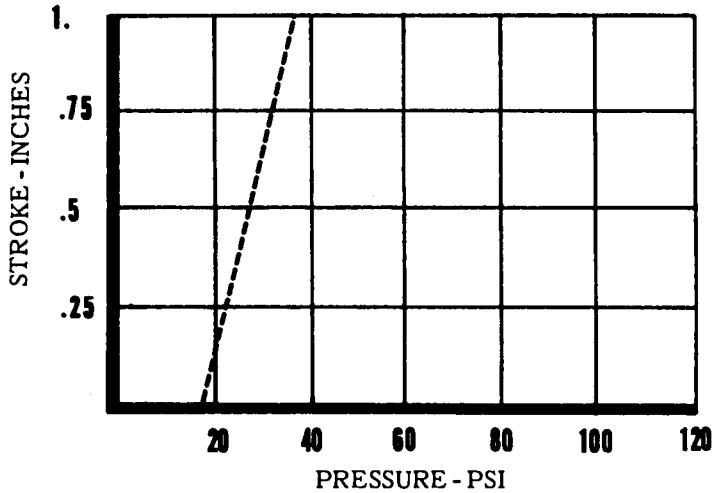
The accompanying graph shows pressure in psi required to overcome the force of the spring as the piston rod is retracted or extended from its center position. Opposing spring force increases as the stroke length of the piston rod increases and the spring is further compressed. From the graph, pounds of spring force can be determined by multiplying the pressure (psi) by the piston area. Thus, the initial force of the cylinder at zero stroke is:

Pounds of force (retracted stroke) = applied pressure (psi) x 2.2 square inches
minus (18 psi x 2.4 square inches)

Pounds of force (extended stroke) = applied pressure (psi) x 2.4 square inches
minus (18 psi x 2.4 square inches)

For spring force at subsequent piston rod positions on either retracted or extended stroke, project across the graph from the appropriate stroke length point on the vertical line until the pressure line is intersected. Project down from this point to arrive at pressure in psi. Multiply this figure by the 2.4 square inches of piston area.

(all three-position models)



PISTON AREA: EXTENDING = 2.4 square inches **(1548 sq. mm)**
RETRACTING = 2.2 square inches **(1419 sq. mm)**

Specifications:

Operating pressure:	150 psi (10.3 bar) max.
Temperature range:	-40° F to 180°F (-40° C to 82° C)
Ports:	1/4” NPTF
Mounting:	integral female clevis

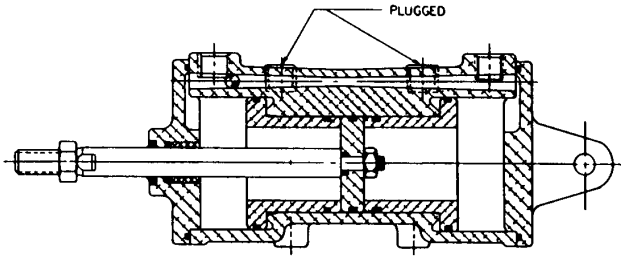
The three-position cylinder is a positioning device controlled by a four-way, three-position, open-center control valve such as the “A” or “D” Pilotair® valves. The cylinder has a wide range of applications, being particularly suited for shifting transmissions and positioning hydraulic valves. It is corrosion-resistant and constructed of lightweight, die-cast, anodized aluminum heads, pistons and body.

Maximum stroke of the piston rod for each cylinder is 13/16” (20.6 mm) on each side of the center position, making a total piston rod travel of 1-5/8” (41.3 mm). External envelope dimensions of the cylinder do not change, but shorter strokes are available in increments of 1/6” (1.6 mm) for each position. The complete model number (same as old part number) for the cylinder and the piston stop will have an identical five-digit suffix. The first digit is always zero; the last four digits show the stroke in thousandths of an inch.

Installation & Adjustment
Because cylinders are installed at the end of the air system, they are vulnerable to dirt and moisture carried through the air lines. Therefore, before installing the three-position cylinder, all air lines in the system should be blown clean. It is recommended that the cylinder be mounted with the ports facing down. Gravity can then assist in preventing foreign material from accumulating in the cylinder by removing it through the control valve exhaust.

In providing a mounting for the cylinder, an adjustable link must be included between the piston rod and the lever to which the rod is connected. The cylinder stroke should be checked in its center position when aligned with the lever to be operated. Supply air through Port One and Port Four, and check for exact register. In the center position, the clevis pin should be free from load.

Operation
Maximum operating pressure of the three-position cylinder is 150 psi (10.3 bar) at a temperature range of –40° F to 180° F (-40° C to 82° C). The cylinder is held in its center position by equal pressure being applied to both sides of the piston through Port One and Port Four. Port Two and Port Three are open to atmosphere through breather plugs. When pressure is supplied through Port Four only, the piston rod moves to its extended position. When pressure is supplied through Port One only, the piston rod moves to its retracted position.



Assembly View

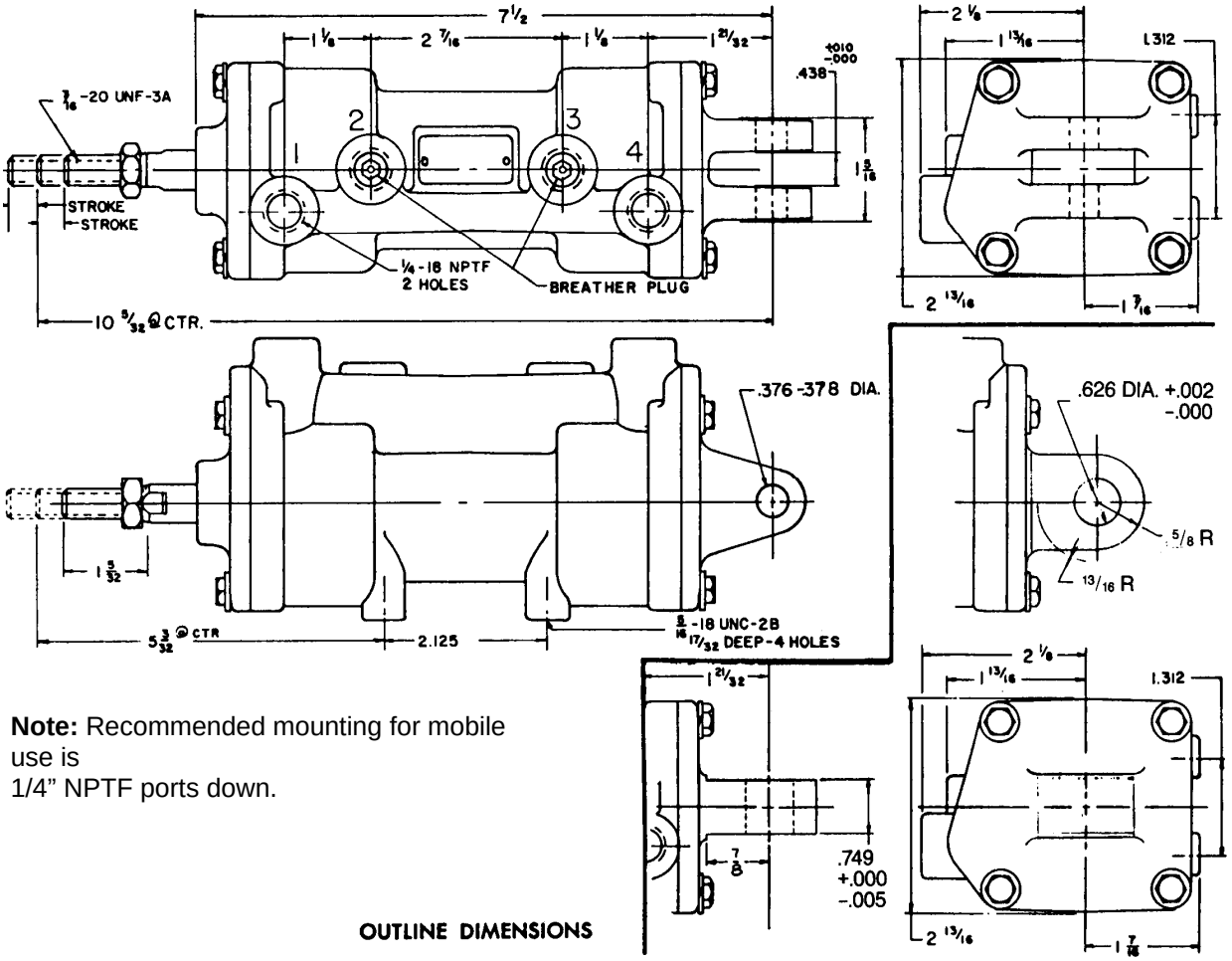
The forces developed by the cylinder are functions of exposed piston areas and amount of air pressure applied, and are shown in the following table according to rod position.

Net Force with 100 psi (6.9 bar) Air Pressure	Pounds (N)	Ports Supplied
Extended to Neutral	171 (761)	1 & 4
Neutral to Extended	207 (921)	4
Neutral to Retracted	188 (836)	1
Retracted to Neutral	210 (934)	1 & 4

Ordering Information

Part No.	Old Part No./ Model Code	Stroke (each side of center) in. (mm)
R431004114	P -057400-00312	5/16 (7.9)
R431004115	P -057400-00375	3/8 (9.5)
R431004116	P -057400-00438	7/16 (11.1)
R431004117	P -057400-00500	1/2 (12.7)
R431004118	P -057400-00562	9/16 (14.3)
R431004119	P -057400-00688	11/16 (17.5)
R431004120	P -057400-00750	3/4 (19.1)
R431004121	P -057400-00812	13/16 (20.6)

Repair kit part number: R431005087 (old P –059385-00000). With this repair kit, the elastomer seals and some common wear parts on the component are renewed. On severely worn or damaged components, additional parts may be required. For additional parts, information and service instructions, refer to Service Manual SM-1000-4911.



Note: Recommended mounting for mobile use is
1/4” NPTF ports down.

OUTLINE DIMENSIONS

Specifications:

Operating pressure:	150 psi (10.3 bar) max.
Temperature range:	-40° F to 180°F (-40° C to 82° C)
Ports:	1/4” NPTF
Mounting:	integral female clevis

The four-position cylinder is a positioning device controlled by a four-position control valve such as the 2-HA-3 Pilotair® valve. The cylinder has a wide range of applications, being particularly suited for shifting transmissions and positioning hydraulic valves. It is corrosion-resistant and constructed of lightweight, die-cast, anodized aluminum heads, pistons and body.

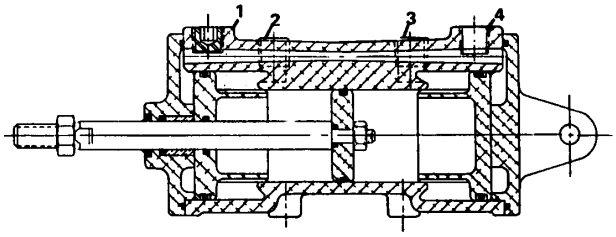
Maximum stroke of the piston rod for each cylinder is 3/4” (19.1 mm) between each of the four positions, making a total piston rod travel of 2-1/4” (57.2 mm). External envelope dimensions of the cylinder do not change, but shorter strokes are available in increments of 1/6” (1.6 mm) for each position. The complete model number (same as old part number) for the cylinder and the piston stop for cylinders with equal-stroke increments will have an identical five-digit suffix. The first digit is always zero; the last four digits show the stroke in thousandths of an inch.

Installation & Adjustment
Because cylinders are installed at the end of the air system, they are vulnerable to dirt and moisture carried through the air lines. Therefore, before installing the four-position cylinder, all air lines in the system should be blown clean. It is recommended that the cylinder be mounted with the ports facing down. Gravity can then assist in preventing foreign material from accumulating in the cylinder by removing it through the control valve exhaust.

In providing a mounting for the cylinder, an adjustable link must be included between the piston rod and the lever to which the rod is connected. The cylinder stroke should be checked in one of its intermediate positions when aligned with the lever to be operated. Supply air as indicated in the “Rod Position - Ports Supplied” table on this page, and check for exact register. In this position, the clevis pin should be free from load.

This procedure will allow any inaccuracies in leverage ratio or manufacturing tolerance to be absorbed at the extremes of the stroke where exact registration is of least importance. Also, any inaccuracies will be divided between the extreme positions. When alignment is done at one of the extreme positions, inaccuracies are all in the same direction.

Operation
Maximum operating pressure of the four-position cylinder is 150 psi (10.3 bar) at a temperature range of –40° F to 180° F (-40° C to 82° C). The cylinder assumes any one of its four positions when air pressure from the control valve is supplied in accordance with the table below.



Assembly View

The forces developed by the cylinder are functions of exposed piston areas and amount of air pressure applied, and are shown in the following table according to rod position.

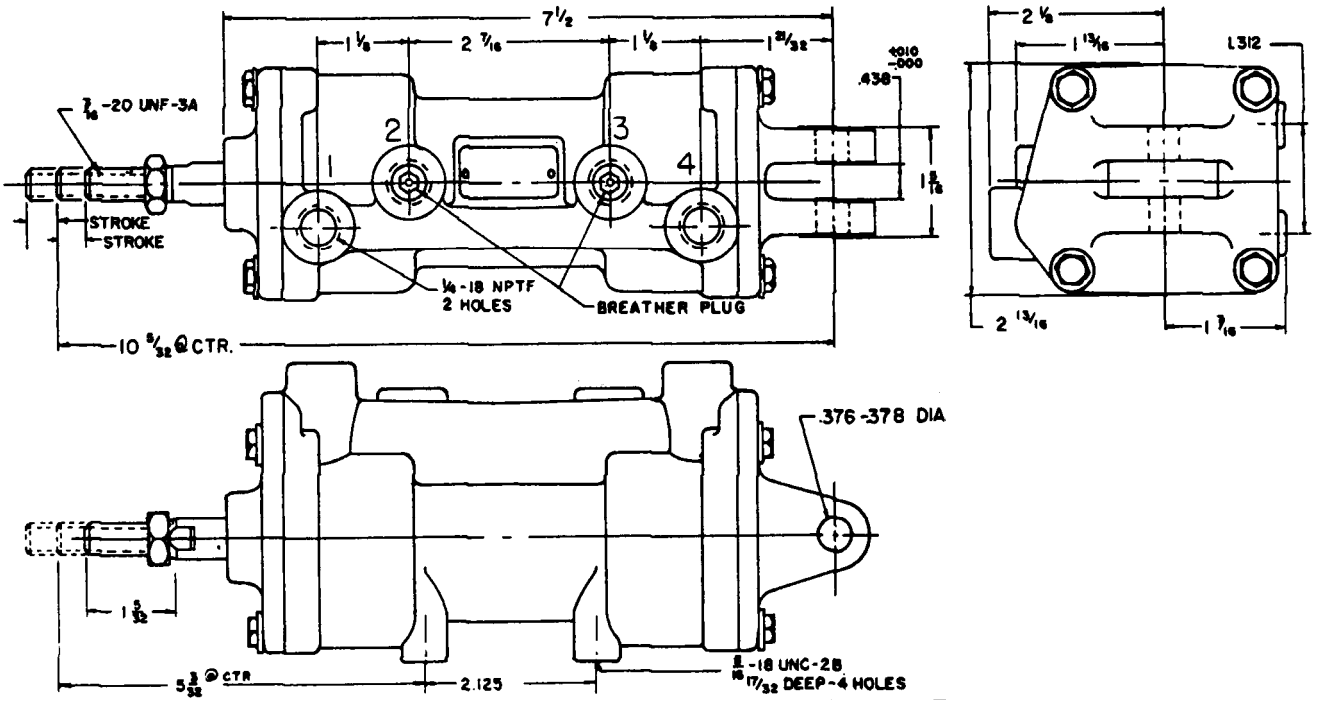
Rod Position - Ports Supplied

Net Force with 100 psi (6.9 bar) Air Pressure	Pounds (N)	Ports Supplied*
Pos. 1 (extended) to Pos. 2	171 (761)	3 & 4
Pos. 2 to Pos. 1	207 (921)	3
Pos. 2 to Pos. 3	188 (836)	2 & 4
Pos. 3 to Pos. 2	210 (934)	3 & 4
Pos. 3 to Pos. 4	188 (836)	2
Pos. 4 (retracted) to Pos. 3	210 (934)	2 & 4

*Ports 1 & 4 are internally connected.

Ordering Information		
Part No.	**Old Part No./ Model Code**	**Stroke (each side of center) in. (mm)**
R431004082	P -057386-00375	3/8 (9.5)
R431004083	P -057386-00500	1/2 (12.7)
R431004084	P -057386-00625	5/8 (15.9)
R431009110	P -057386-00688	11/16 (17.5)
R431004085	P -057386-00750	3/4 (19.1)

Repair kit part number: R431005250 (old P –059820-00000). With this repair kit, the elastomer seals and some common wear parts on the component are renewed. On severely worn or damaged components, additional parts may be required. For additional parts, information and service instructions, refer to Service Manual SM-1000-4921.



Note: Recommended mounting for mobile use is 1/4” NPTF ports down.

OUTLINE DIMENSIONS

Specifications:

Operating pressure:	250 psi (17.2 bar) max.
Temperature range:	-40° F to 160°F (-40° C to 71° C)
Ports:	1/4" NPTF
Mounting:	mounting holes in body

The five-position cylinder is a positioning device which will assume five unique positions; part number R431005635 increments are 7/16" (11.1 mm), part number R431009120 increments are 1/4", 5/8", 5/8" and 1/4" (6.4, 15.9, 15.9 and 6.4 mm). The cylinder was designed primarily for transmission shifting, however, is easily adaptable for general use. The cylinder is constructed of rugged corrosion-resistant materials and is designed to operate at pressures up to 250 psi (17.2 bar).

The five-position cylinder is operated by a 2-HA-4 Pilotair® valve, part number R431004541 (see catalog SC-700). Install the valve and connect the four lines to the cylinder. Connect valve port 1R to cylinder port 2, valve port 2L to cylinder port 3, valve port 1L to cylinder port 4 and valve port 2R to cylinder ports 1 and 5 externally.

Ordering Information

Part No.	Old Part No./ Model Code	Stroke increments
R431005635	P -060960-00002	7/16"
R431009120	P -068501-00000	1/4", 5/8", 5/8" & 1/4"

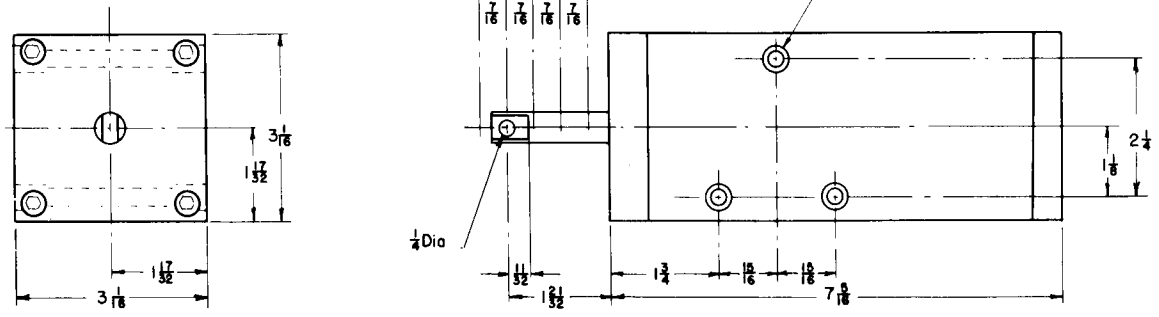
Repair kit part number: R431005658 (old P –061067-00000). With this repair kit, the elastomer seals and some common wear parts on the component are renewed. On severely worn or damaged components, additional parts may be required. For additional parts, information and service instructions, refer to Service Manual SM-1000.4901.

The following table illustrates the operation of the cylinder in each of the five positions:

CYLINDER PARTS	PORTS TO WHICH PRESSURE IS SUPPLIED				
	1	2	3	4	5
F_3		X			
F_2		X		X	
F_1	X	X			X
N	X		X		X
R			X		

The thrust available at the end of the piston rod varies as it travels from one position to another. The following tabulation illustrates these thrusts according to the direction of travel while the cylinder is operating with a supply pressure of 100 psi (6.9 bar).

F3 to F2 - 182 pounds (810)
F2 to F1 - 182 pounds (810)
F1 to N - 191 pounds (850)
N to R - 191 pounds (850)
R to N - 143 pounds (636)
N to F1 - 172 pounds (765)
F1 to F2 - 152 pounds (676)
F2 to F3 - 172 pounds (765)



Specifications:

Operating pressure:	150 psi (10.3 bar) max.
Temperature range:	-40° F to 160°F (-40° C to 71° C)
Ports:	1/4” NPTF
Mounting:	integral mounting lugs

The six and seven position cylinders are medium duty pneumatic positioning devices that operate through six or seven pre-determined positions of 1/2” (12.7 mm) increments with total strokes of 2-1/2” (63.5 mm) or 3” (76.2 mm) respectively. They were primarily designed for power-shift transmissions but may also be utilized for indexing and any other application where fixed stroke increments are required. The ideal companion valve for these cylinders is AVENTICS “P” Rotair® six or seven position valve. An alternative control is an electro-pneumatic switching circuit using 3-way solenoid valves. These cylinders are extremely rugged, having anodized, corrosion-resistant, lightweight aluminum body, pistons and piston stops. Seals are a Teflon coated nitrile compound.

Installation
Mount the cylinders in any desirable plane to a sturdy, flat surface (preferably with the ports facing down) with three 3/8” bolts. Mounting lugs are cast in the body of the cylinders. Avoid misalignment with the load to be positioned since side thrust and binding will affect the service life of the rod bearing and piston stop seals.

All ports are 1/4”-18 NPTF. The following ports should be piped together with “T” connections: 3 with 3A on the six position cylinder, 3 with 3A and 6 with 6A on the seven position cylinder. Connections should be made as close to the cylinder as possible to reduce the number of lines from the control valve.

Operation
Maximum operating pressure is 150 psi (10.3 bar) at a temperature range of –40° F to 160° F (-40° C to 71° C). The cylinder piston rod reaches its various positions in response to pressure being supplied to the cylinder ports as shown in the porting diagrams, V means air must be vented to atmosphere, S means air must be supplied and S/V means port can be supplied or vented, whichever is most convenient in the control valve. Each cylinder has reverse at full extended position of the rod and is spring returned to neutral (next position in from reverse) from any position. The transmissions which these cylinders usually control have the full automotive or drive position adjacent to neutral. The corresponding position is 5 on the seven position and 4 on the six position cylinder. The sequential order of cylinder position is a function of the “P” Rotair valve.

Control Valve Notes: “P” Rotair valve R431006324 was designed to control six position cylinder R431006322 and valve R431006326 was designed to control seven position cylinder R431006321. Both of the Rotair valves have first gear position adjacent to neutral and progress toward full automatic at the extreme position of valve handle travel (see catalog SC-700).

Six position Rotair R431006324 should be connected as follows: ports no. 1 & no. 5 plugged, exhaust port is 1/8” NPTF, pressure is supplied to unnumbered port in the side of the pipe bracket, valve port no. 2 to cylinder port no. 2, valve no. 4 to cylinder no. 5, valve no. 3 to cylinder no. 3 and 3A, and valve port no. 6 to cylinder port no. 6A in six position cylinder R431006322.

Seven position Rotair R431006326 should be connected as follows: port no. 1 plugged, exhaust port is no. 4, pressure is supplied to unnumbered port in the side of the pipe bracket, valve port no. 2 to cylinder port no. 2, valve no. 5 to cylinder no. 5, valve no. 3 to cylinder no. 3 and 3A, and valve port no. 6 to cylinder no. 6 and 6A in seven position cylinder R431006321.

The forces developed by the cylinder are functions of the air pressure applied to the exposed piston area and are tabulated for rod movement at the various stroke positions as shown on the charts on following pages. The internal spring returns the piston rod to its “Neutral” position when air pressure is intentionally or unintentionally exhausted from all control lines. This safety feature returns the transmission to neutral if the air supply is lost.

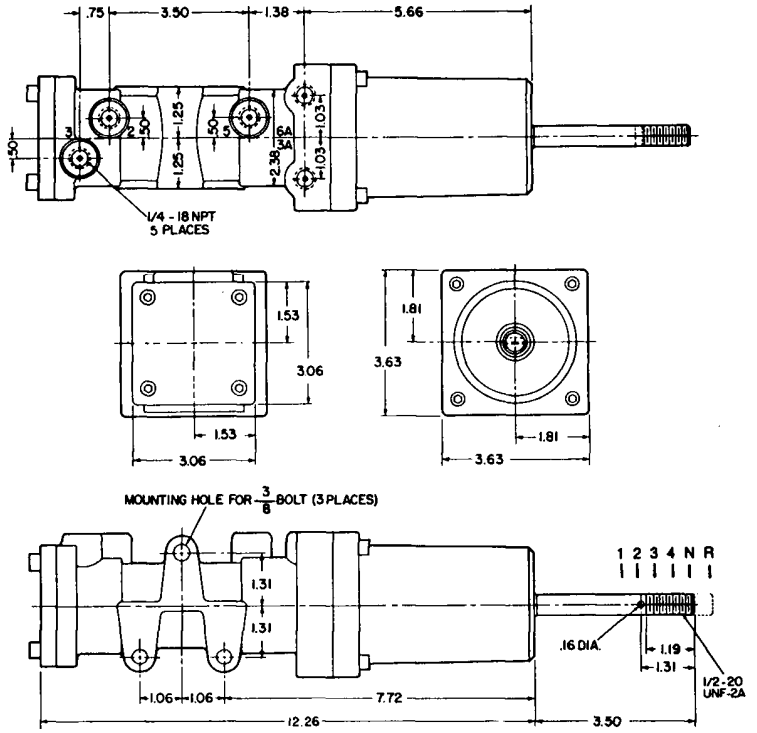
Repair Kit:
R431006546 (old part no. P –064997-00001)
Replacement Spring:
R431006375 (old part no. P –064191-00000)

Service Manual: SM-1000.4905

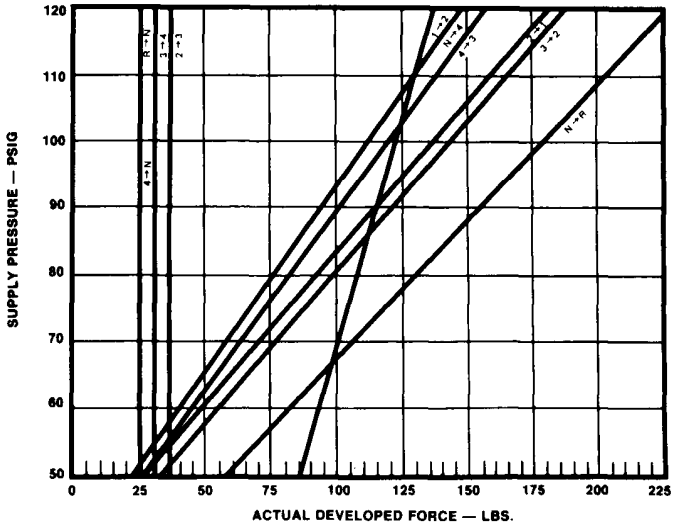
SIX POSITION CYLINDER

M4-N-1B CYLINDER

Cast Aluminum Body

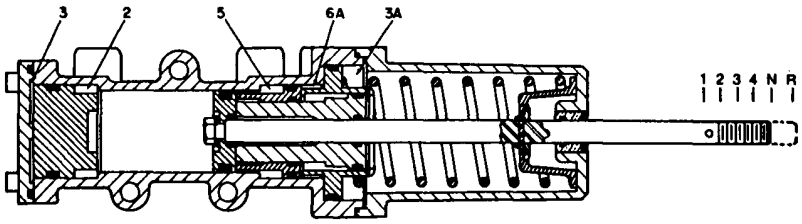


CONDITION OF PORTS					
CYLINDER POSITION	CAVITY				
	3	2	5	3A	6A
R	S/V	S	V	V	V
N	S/V	V	V	V	V
4	SV	V	V	V	S
3	SV	V	V	S	V
2	S	V	S	SV	SV
1	V	V	S	SV	SV
S SUPPLIED				V VENTED	



ASSEMBLY VIEW

PORT & CAVITY NUMBERS

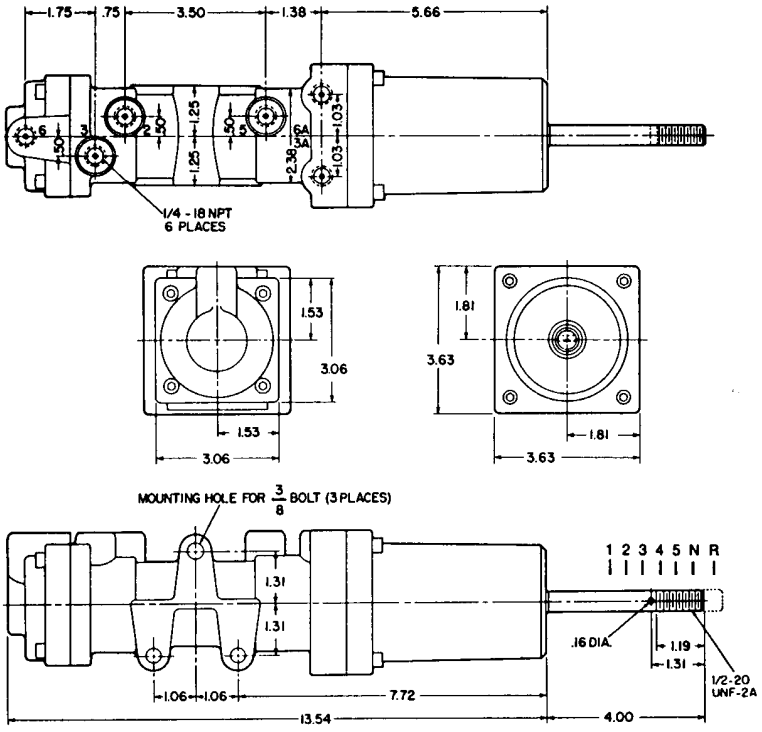


R431006322 (old part no. P –063982-00001

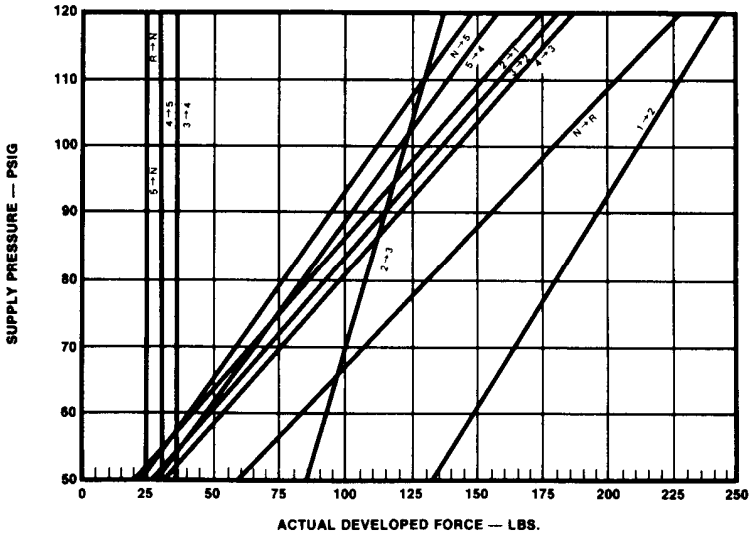
SEVEN POSITION CYLINDER

M5-N-1B CYLINDER

Cast Aluminum Body

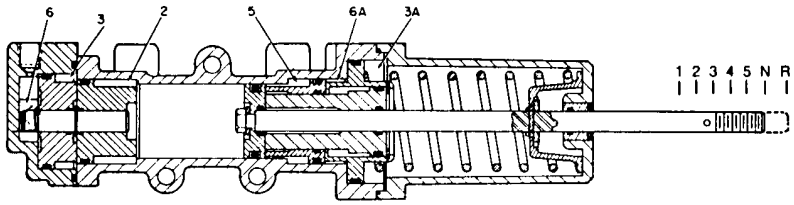


CONDITION OF PORTS						
CYLINDER POSITION	CAVITY					
	6	3	2	5	3A	6A
R	SV	SV	S	V	V	V
N	SV	SV	V	V	V	V
5	SV	SV	V	V	V	S
4	SV	SV	V	V	S	V
3	SV	S	V	S	SV	SV
2	S	V	V	S	SV	SV
1	V	V	V	S	SV	SV
S SUPPLIED					V VENTED	



ASSEMBLY VIEW

PORT & CAVITY NUMBERS



R431006321 (old part no. P –063981-00002)

Specifications:

Operating pressure:	150 psi (10.3 bar) max.
Temperature range:	-40° F to 160°F (-40° C to 71° C)
Ports:	1/4” NPTF
Mounting:	integral mounting lugs
Weight:	11.5 lbs. (5.2 kg)

The eight position cylinder is a medium duty pneumatic positioning device that operates through eight pre-determined positions of 3/8” (9.5 mm) increments with a total stroke length of 2-5/8” (66.7 mm). Although it was primarily designed for power-shift transmissions, it may also be utilized for indexing and any other application where fixed stroke increments are required. The ideal companion valve for the cylinder is AVENTICS “P” Rotair® eight position valve. An alternative control is an electro-pneumatic switching circuit using 3-way solenoid valves. The cylinder is extremely rugged, having anodized, corrosion-resistant, lightweight aluminum body, pistons and piston stops. Seals are a Teflon coated nitrile compound.

Installation
Mount the cylinder in any desirable plane to a sturdy, flat surface (preferably with the ports facing down) with three 3/8” bolts. Mounting lugs are cast in the body of the cylinders. Avoid misalignment with the load to be positioned since side thrust and binding will affect the service life of the rod bearing and piston stop seals.

All ports are 1/4”-18 NPTF pipe size. The following ports should be piped together with “T” connections: 1 with 1A , 3 with 3A and 6 with 6A. Connections should be made as close to the cylinder as possible to reduce the number of lines from the control valve.

Control Valve Notes: When the “P” Rotair valve R431003806 or R431003807 is used, the ports on cylinder R431003808 correspond directly to the port numbers on the valve. When cylinder R431003967 is utilizing port no. 2 on the valve, it should be connected to port no. 5 on the cylinder; and port no. 5 on the valve should be connected to port no. 2 on the cylinder to provide the reversal of the neutral position in that cylinder.

Operation
Maximum operating pressure of the eight-position cylinder is 150 psi (10.3 bar) at a temperature range of –40° F to 160° F (-40° C to 71° C). The cylinder assumes any one of its eight positions when air pressure from the control valve is supplied in accordance with the tables on the following pages.

The forces developed by the cylinder are functions of the air pressure applied to the exposed piston area and are tabulated for rod movement at the various stroke positions as shown on the charts on following pages. The internal spring returns the piston rod to its “Neutral” position when air pressure is intentionally or unintentionally exhausted from all control lines. This is a safety feature that insures against operation in case of loss of air supply.

In the event that an application may not need the above feature, cylinder R431005699 with no return spring is available.

These cylinders should be mounted with the pipe ports pointed down to avoid accumulation of condensate in the cylinder pressure spaces. Drain holes are also provided on the port side in the front spring housing for the same reason on R431003808 and R431003967.

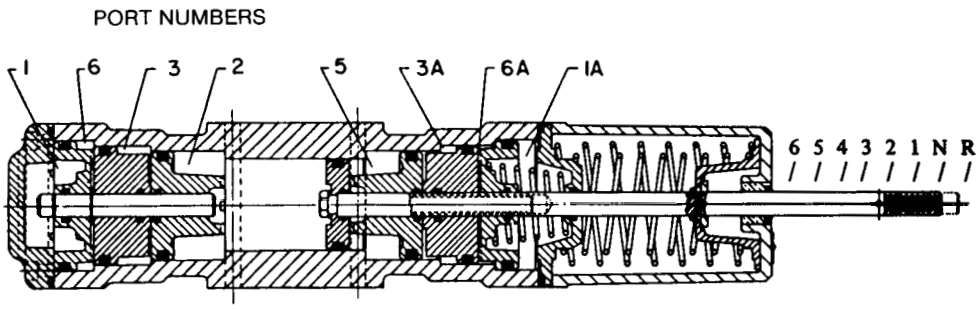
Repair Kit for R431003808:
R431003973 (old part no. P –056556-00005)
Repair Kit for R431003967:
R431003972 (old part no. P –056556-00004)
Repair Kit for R431005699:
R431006462 (old part no. P –064556-00001)

Service Manual: SM-1000.4904

ORDERING REFERENCE
M6-N-1B EIGHT POSITION CYLINDER

Part no. R431003808 (old part no. P –055557-00003)

ASSEMBLY VIEW

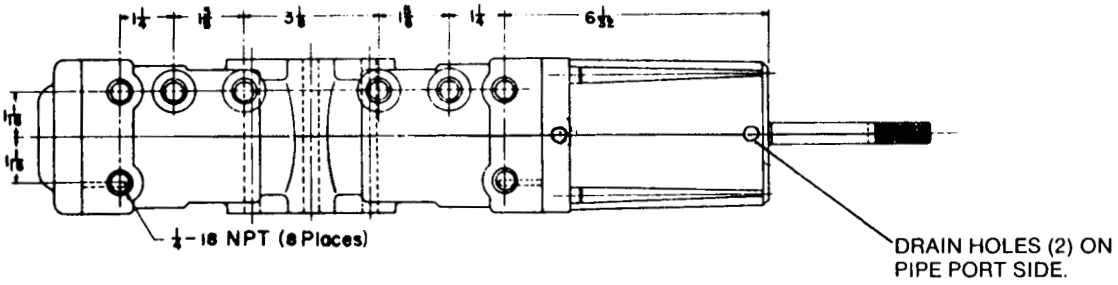


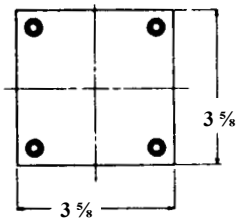
PORTING DIAGRAM

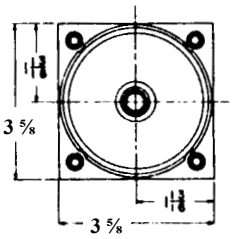
Cyl. Position	CAVITY							
	1	6	3	2	5	3A	6A	1A
R	S/V	S/V	S/V	S	V	V	V	V
N	S/V	S/V	S/V	S	V	V	V	S
F1	S/V	S/V	S/V	V	V	V	S	S/V
F2	S/V	S/V	S/V	V	V	S	S/V	S/V
F3	S/V	S/V	S	V	S	S/V	S/V	S/V
F4	S/V	S	V	V	S	S/V	S/V	S/V
F5	S	V	V	V	S	S/V	S/V	S/V
F6	V	V	V	V	S	S/V	S/V	S/V

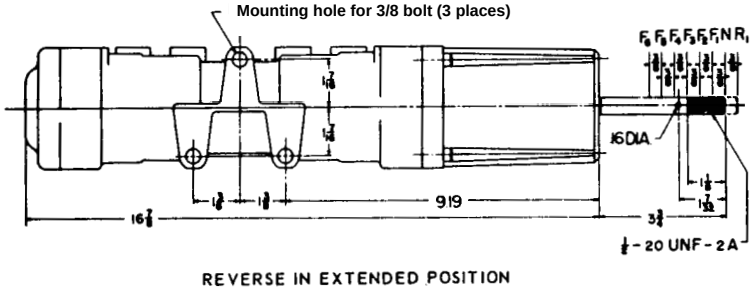
S = Supplied, V = Vented, S/V = Supply or Vented

OUTLINE DIMENSIONS



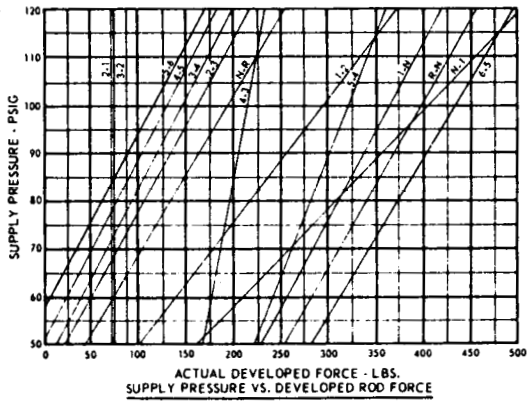






REVERSE IN EXTENDED POSITION

AVAILABLE FORCES



Denotes rod travel from position 5 to position 6 (typical)

Note: Actual force in lbs. available in position N (zero air pressure) 70 lbs.

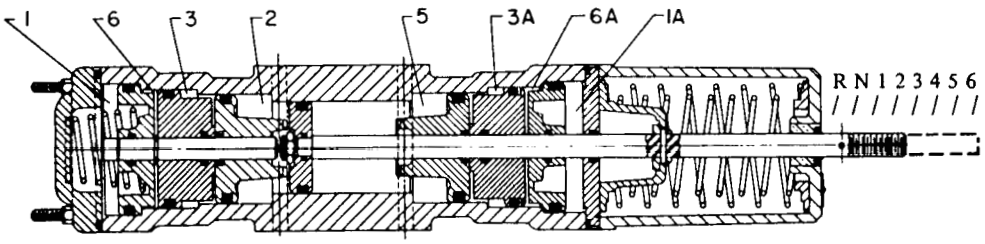
Figure 5

ORDERING REFERENCE
M1-N-6B EIGHT POSITION CYLINDER

Part no. R431003967 (old part no. P –056426-00004)

ASSEMBLY VIEWS

PORT NUMBERS

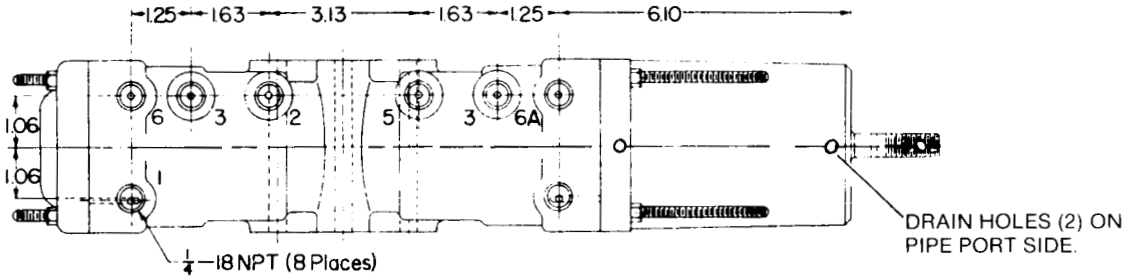


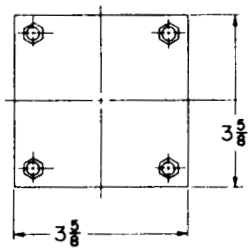
PORTING DIAGRAM

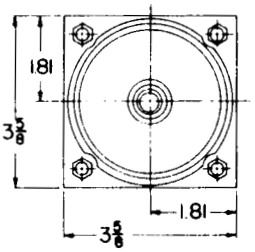
Cyl. Position	CAVITY							
	1A	6A	3A	2	5	3	6	1
R	S/V	S/V	S/V	V	S	V	V	V
N	S/V	S/V	S/V	V	S	V	V	S
F1	S/V	S/V	S/V	V	V	V	S	S/V
F2	S/V	S/V	S/V	V	V	S	S/V	S/V
F3	S/V	S/V	S	S	V	S/V	S/V	S/V
F4	S/V	S	V	S	V	S/V	S/V	S/V
F5	S	V	V	S	V	S/V	S/V	S/V
F6	V	V	V	S	V	S/V	S/V	S/V

S = Supplied, V = Vented, S/V = Supply or Vented

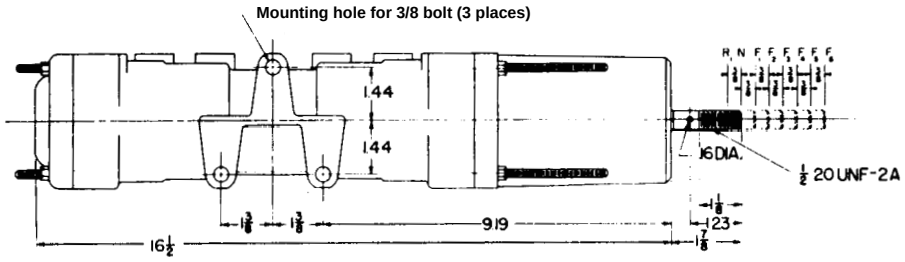
OUTLINE DIMENSIONS



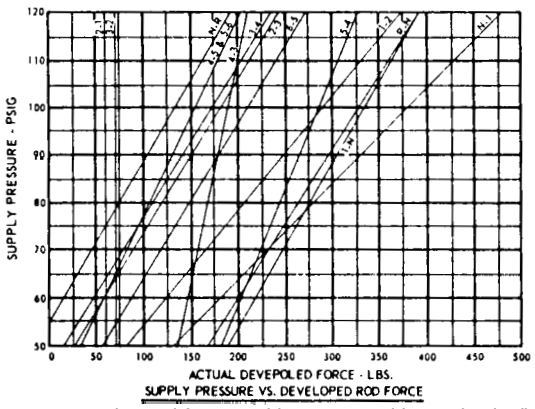




REVERSE IN RETRACTED POSITION



AVAILABLE FORCES



Denotes rod travel from position N to position R (typical)

Note: Actual force in lbs. available in position N (zero air pressure) 70 lbs.

Figure 6

ORDERING REFERENCE
M8 EIGHT POSITION CYLINDER

Part no. R431005699 (old part no. P –061185-00002)

PORTING DIAGRAM

Cyl. Position	CAVITY							
	1	6	3	2	5	3A	6A	1A
1	S/V	S/V	S/V	S	V	V	V	V
2	S/V	S/V	S/V	S	V	V	V	S
3	S/V	S/V	S/V	S	V	V	S	S/V
4	S/V	S/V	S/V	S	V	S	S/V	S/V
5	S/V	S/V	S	V	S	S/V	S/V	S/V
6	S/V	S	V	V	S	S/V	S/V	S/V
7	S	V	V	V	S	S/V	S/V	S/V
8	V	V	V	V	S	S/V	S/V	S/V

S = Supplied, V = Vented, S/V = Supply or Vented

PORT NUMBERS

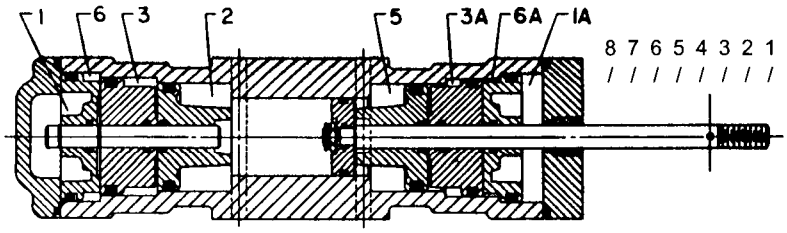
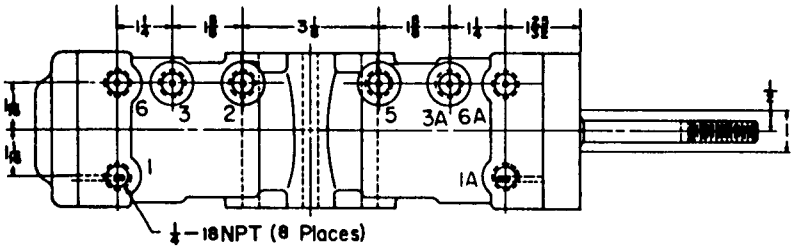
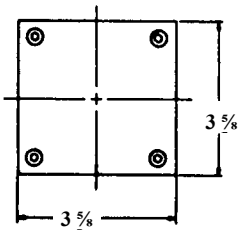
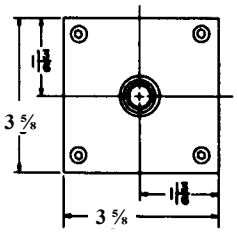


Figure 4

OUTLINE DIMENSIONS





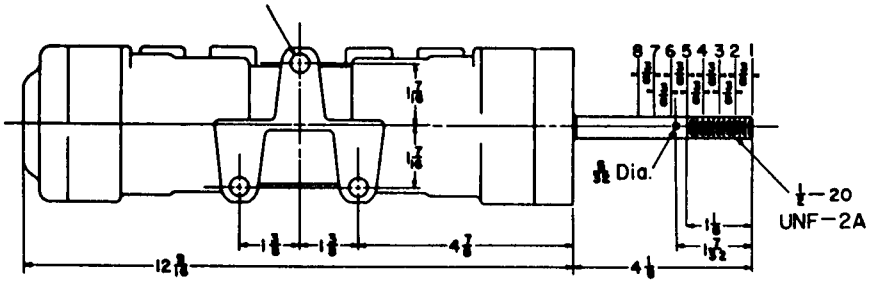


Available Forces

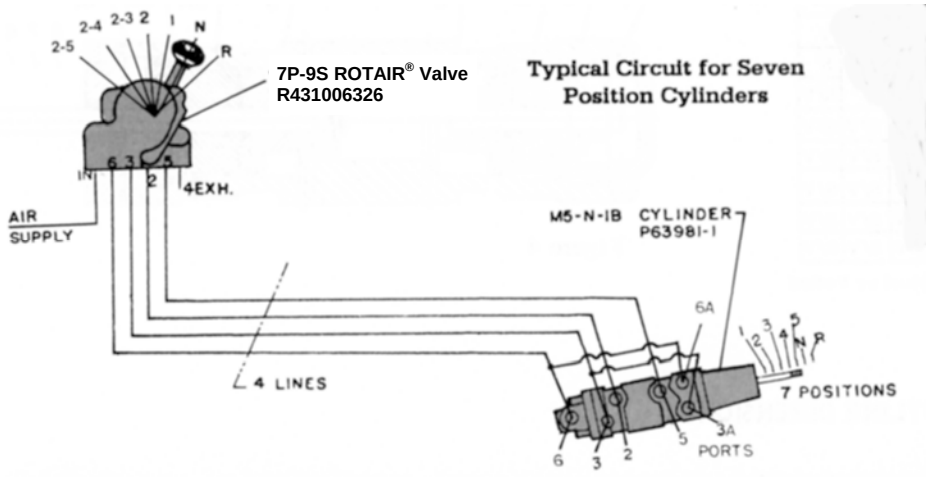
Movement	Net Area	Ff
2 ← 1	3.12	28.1
2 → 1	3.14	19.9
3 ← 2	2.06	2.4
3 → 2	3.14	19.9
4 ← 3	1.06	10.1
4 → 3	3.14	16.6
5 ← 4	2.95	8.4
5 → 4	3.14	10.0
6 ← 5	2.95	16.9
6 → 5	1.25	16.4
7 ← 6	2.95	16.9
7 → 6	2.25	11.6
8 ← 7	2.95	18.1
8 → 7	3.31	15.6

P = Pressure
A = Net Area in^2
Ff = Approximate Friction in lbs.
Force = (P x A) - Ff

Mounting hole for 3/8 bolt (3 places)



The basic AVENTICS pneumatic multi-position control system consists of a multi-position power cylinder and a rotary type selector valve connected by only air lines. An air supply pressure in the range of 90 - 150 psig (6.2 - 10.3 bar) is connected to the rotary valve. For each handle position of the rotary valve, a different combination of the air lines is pressurized - causing the cylinder to move to corresponding positive positions and hold in these positions. A typical single circuit for seven position cylinders is diagrammed below. (see pages 30-34 for other circuits)



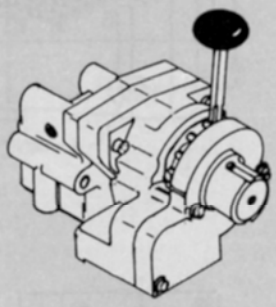
7P-9S ROTAIR® Pneumatic Directional Valve - R431006326

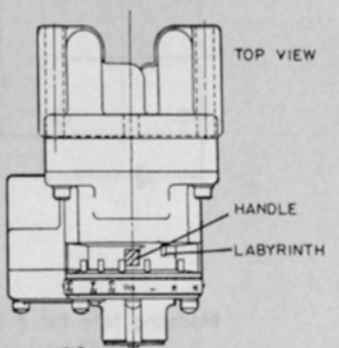
Consists of a subplate portion containing air strainers in each port connection, a seat and rotary disc valve section, a handle operating section containing the handle labyrinth and position detents, and an interlock switch section with a SPDT switch depressed only when the handle is in N position. Note the open labyrinth design which permits the handle to be moved quickly between desired positions and to N Position. Detents for each position permit the operator to feel the handle location for each selection. When the handle is released, it spring offsets between two pins to help prevent inadvertent operation. A complete description, dimensions, parts and service information is contained in service manual SM-700.7600.

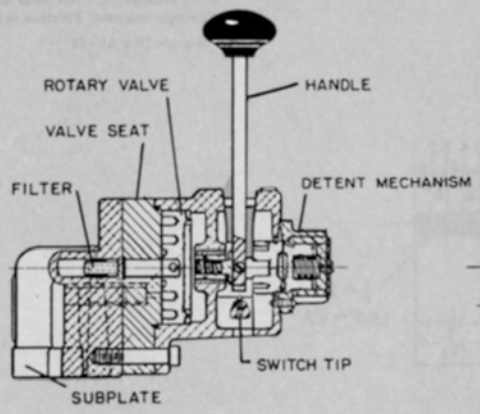
Porting Diagram
Part no. R431006326 7P-9S ROTAIR Valve

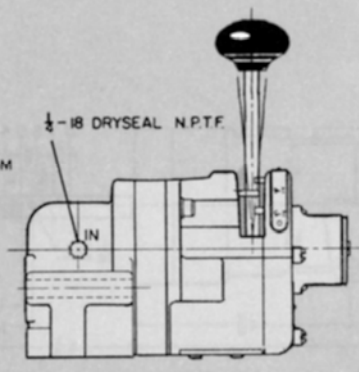
HDL. POS.	PRESSURE SUPPLIED TO PORTS			
	6	3	2	5
R			X	
N				
1				X
2	X			X
2-3	X	X		X
2-4		X		
2-5	X			

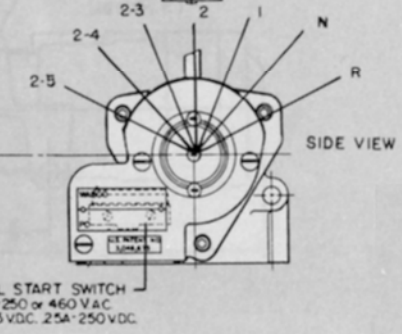
Port in side of the pipe bracket is "IN" port. Port #4 is exhaust. #1 is plugged.

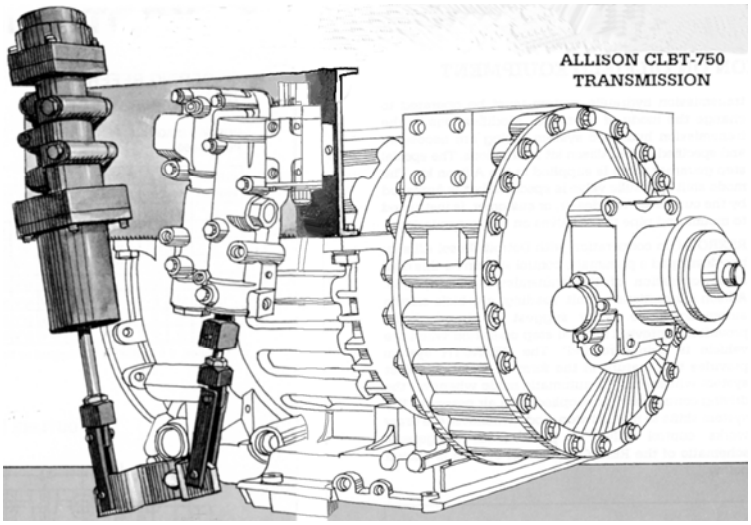












LINEAR POSITIONING CYLINDER

- Positive linear positioning
- Each position held with rated forces
- Six or seven positions
- Cylinder forces can position both automatic selection lever and manual step control valve
- Spring return to neutral on loss of air pressure
- Minimum number of parts
- Easy service

ROTARY CONTROL VALVE

- Multi-position valve handle permits quick selection of any speed
- Valve position sequence: R-N-F1-F2-F3-F4-F5 (manual mode); R, N, 1, 2, 2-3, 2-4, 2-5 (automatic mode)
- Quick shift to N with open labyrinth & detents on valve handle
- Neutral position interlock switch
- SPDT switch built in valve for starting interlock
- Compact, subplate mounting for easy servicing
- Integral line filters in valve assembly

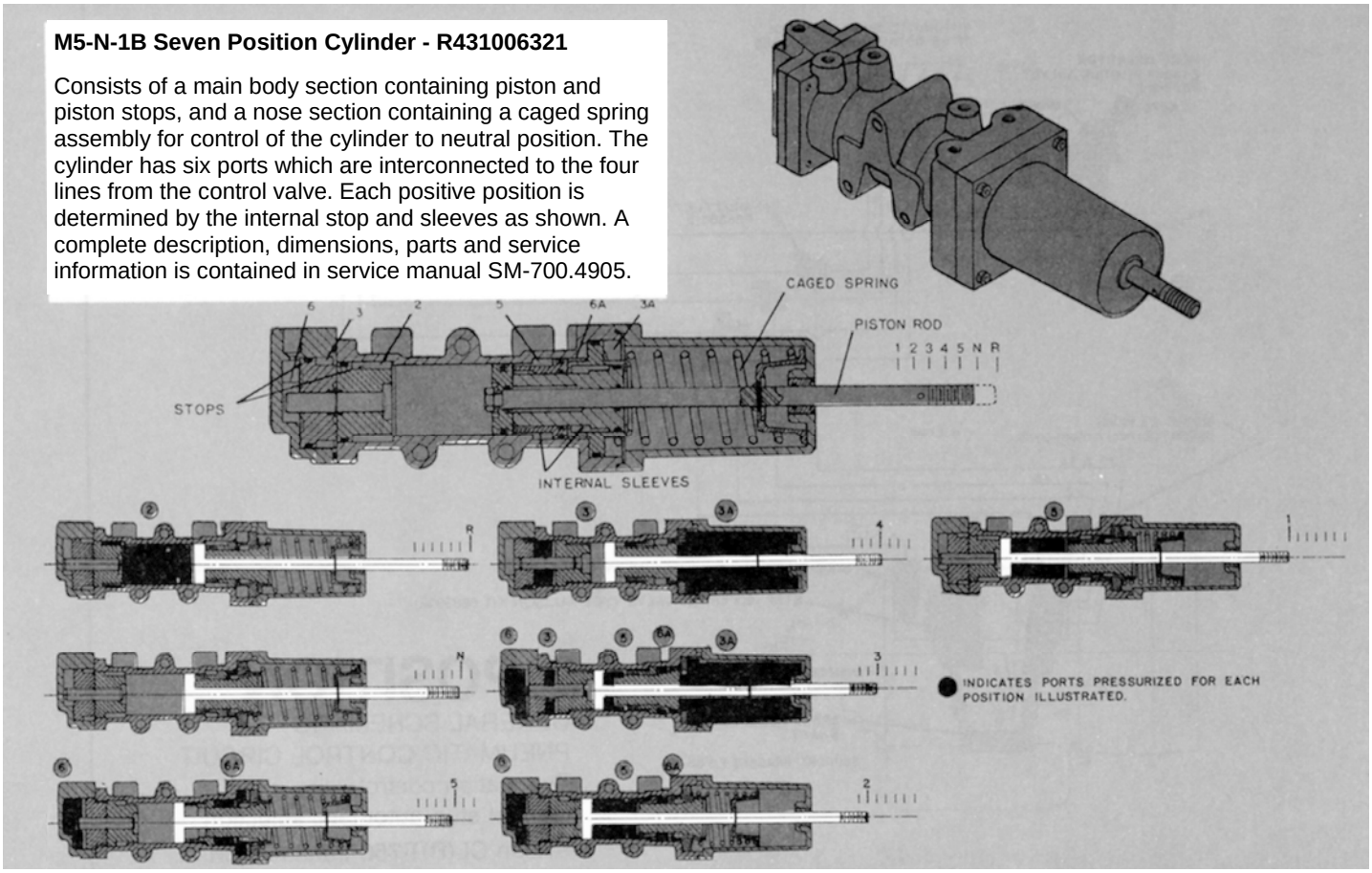
NO ELECTRICAL CONNECTIONS OR CABLE REQUIRED FOR OPERATION

- Only four (4) air line connections from cylinder to valve
- Wiring is required for neutral start switch (interlock)

MULTIPLE STATION CONTROL • EASY MOUNTING

M5-N-1B Seven Position Cylinder - R431006321

Consists of a main body section containing piston and piston stops, and a nose section containing a caged spring assembly for control of the cylinder to neutral position. The cylinder has six ports which are interconnected to the four lines from the control valve. Each positive position is determined by the internal stop and sleeves as shown. A complete description, dimensions, parts and service information is contained in service manual SM-700.4905.



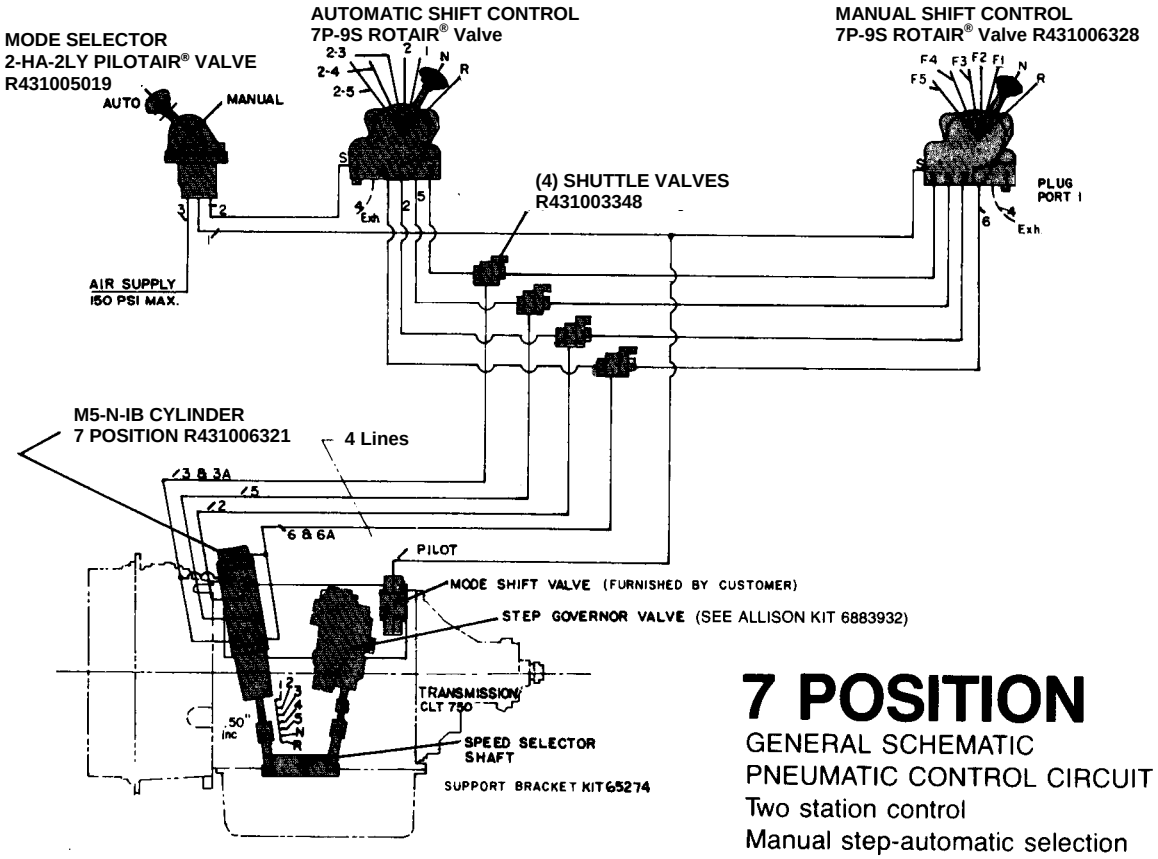
ALLISON 750 SERIES TRANSMISSION FOR MANUAL/AUTOMATIC OPERATION ON OILFIELD EQUIPMENT

Allison Transmission obsoleted the model CLT 4460 transmission used widely on mobile oil well drilling and servicing equipment. It was replaced with the 750 series transmission.

The CLT 4460 transmission was a manual power-shift model and the CL(B)T-750 is basically an automatic shift model. In response to oilfield requirements, Allison developed a manual/automatic kit for the CL(B)T-750 transmission which permits the selection of either full automatic or manual step operation. This permits a mobile rig to be “roaded” in full automatic and “worked” with manual step control for speed selection.

This dual mode kit is Allison part 6883932 and is fully described in Allison instruction sheet 109 and drawing AS45-052. For manual/automatic control 6883940 and two additional components must be installed and operated in conjunction with the normal speed selector shaft. The separate step governor valve must be operated in synchronization with the speed selector shaft, and a mode shift valve connected in the transmission hydraulic system must be operated to change the mode of operation. Modifications to the transmission hydraulic system piping are necessary and specified in the Allison kit instructions. The special step governor valve is supplied in the Allison kit. The mode shift hydraulic valve is specified but is furnished by the customer. The dealer, or customer, is instructed to mount and pipe these valves on the transmission.

AVENTICS, in cooperation with Allison Transmission, developed a pneumatic control system for this dual mode operation of the transmission, CL(B)T-750. Allison instructions permit “roading” a vehicle only in automatic mode. They suggest an interlock be provided to prevent manual step operation when the vehicle is being “roaded”. The AVENTICS system provides this feature in the form of a station select system which shifts to automatic mode whenever the driving control valve is supplied with air pressure. The system shifts to manual step mode whenever the draw works control valve is pressurized. A general schematic of the AVENTICS control system is shown below.

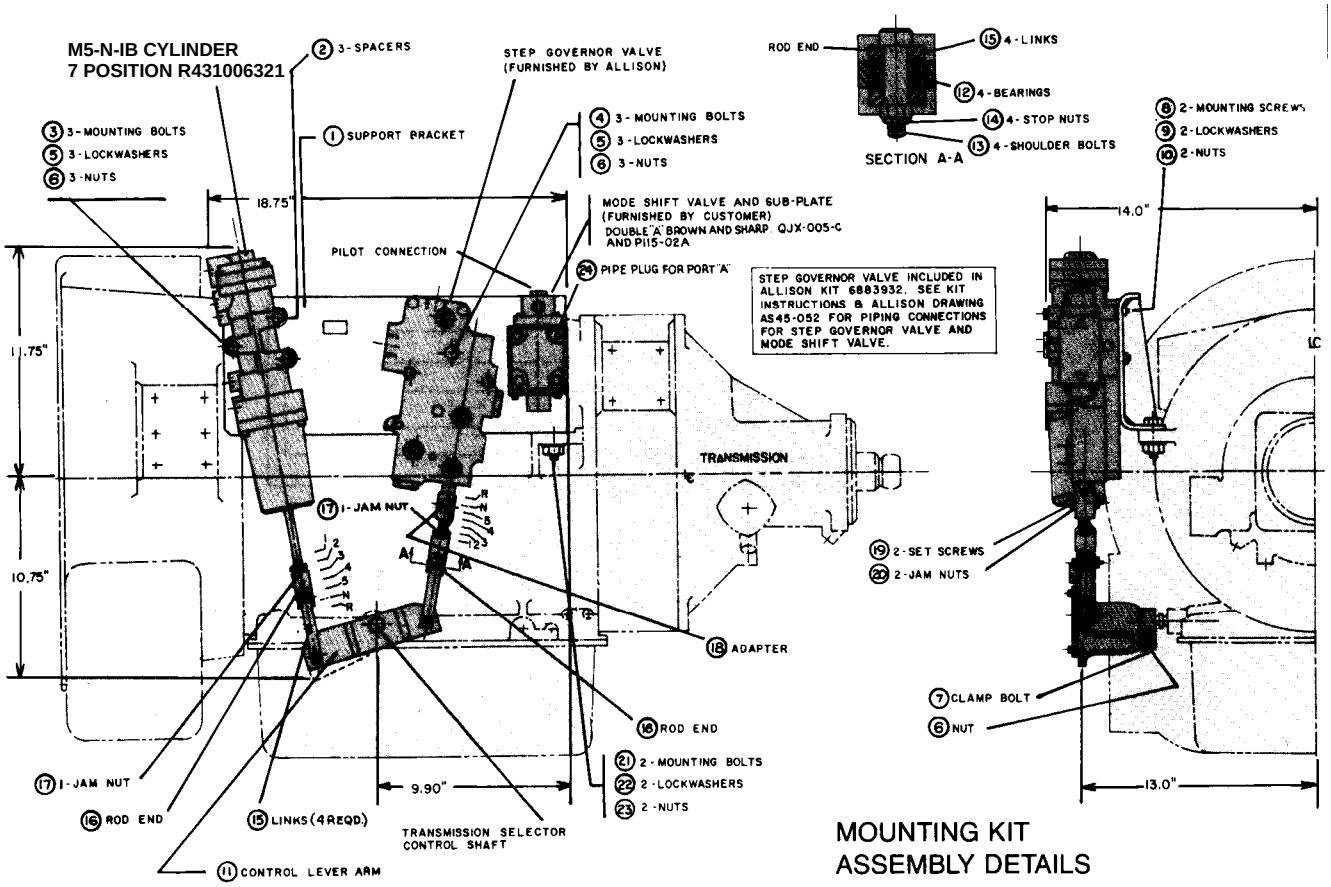


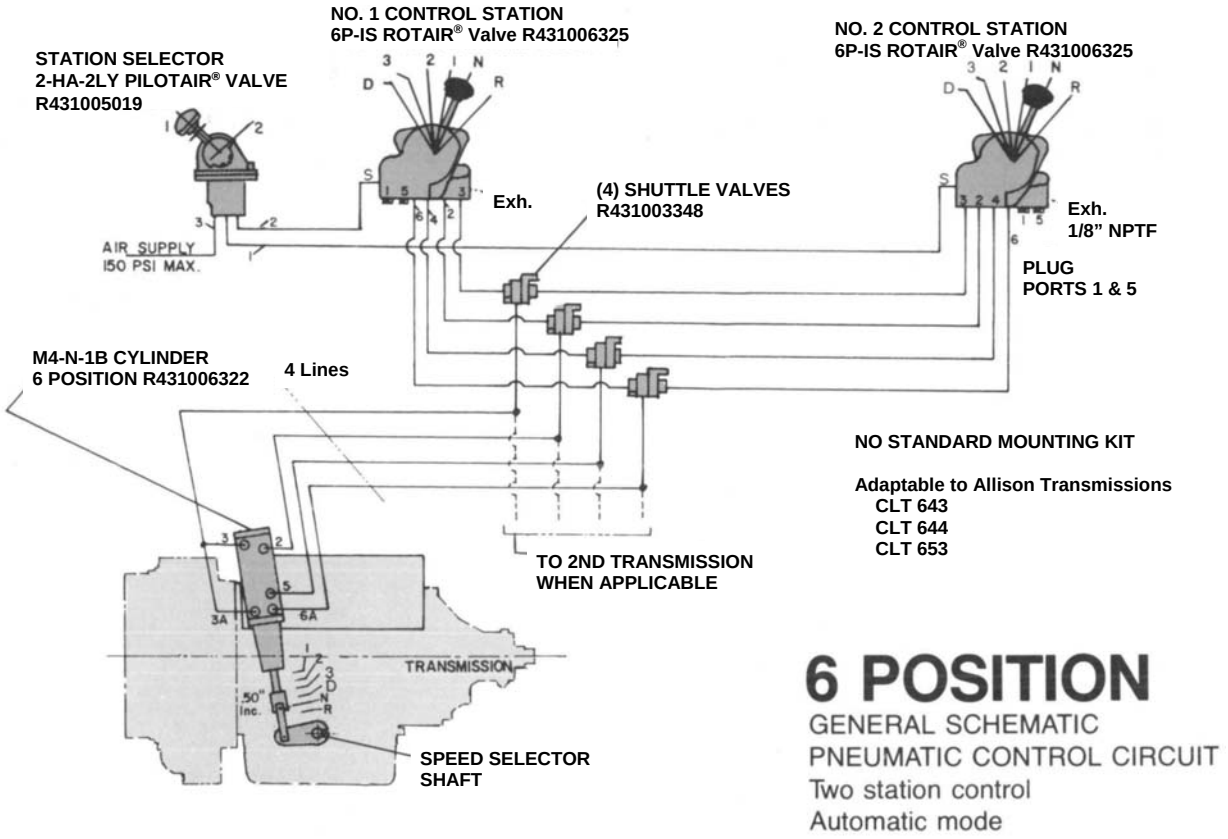
7 POSITION
GENERAL SCHEMATIC
PNEUMATIC CONTROL CIRCUIT
Two station control
Manual step-automatic selection
Allison CL(B)T-750 transmission

AVENTICS also developed, with Allison's approval, a bracket kit R431006590 for mounting the multi-position cylinder, step governor valve and the mode shift valve to the transmission. It consists of a mounting bracket and the necessary linkage to mount and actuate the speed selector shaft and step governor valve simultaneously as required. The bracket is attached to the two machining lugs on the selector shaft side of the transmission as shown below. The AVENTICS multi-position cylinder provides the seven increments of stroke to position the selector shaft and step governor valve. The assembly is mounted to the side of the transmission and projects about 4" (102 mm) outside the transmission envelope in places. There is sufficient clearance for most typical installations.

The seven-position control system shown on page 30 is covered by part number R431006626. By ordering this one kit part number, all of the AVENTICS components shown which include the seven-position cylinder, Rotair® valves, "A" Pilotair® valve, shuttle valves, bracket and linkage kit are available from AVENTICS and authorized distributors.

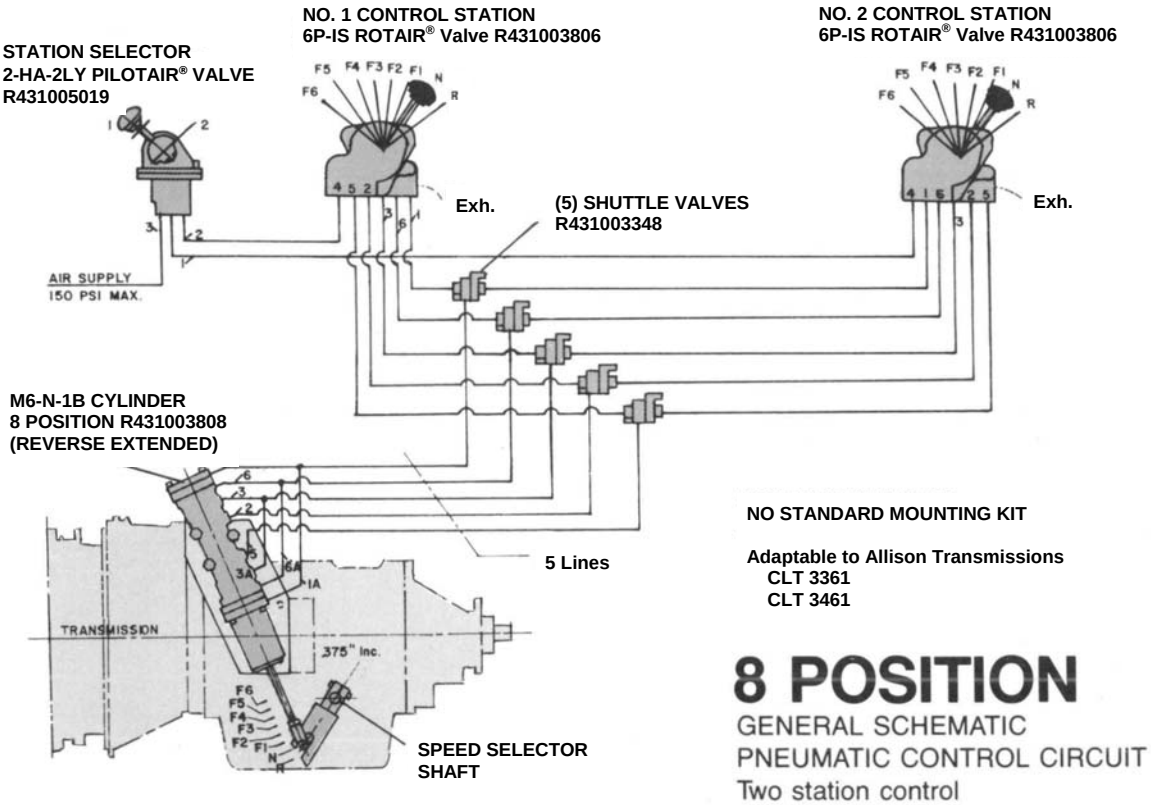
Mounting Kits		
Transmission	**Shaft Type**	**Kit Part No.**
CLBT 750	Serrated	R431006590
CLT 750	Serrated	R431006590
CLT 754	Serrated	R431006590
CLT 750	Flattened	R431006873
HT 750	Flattened	R431006873





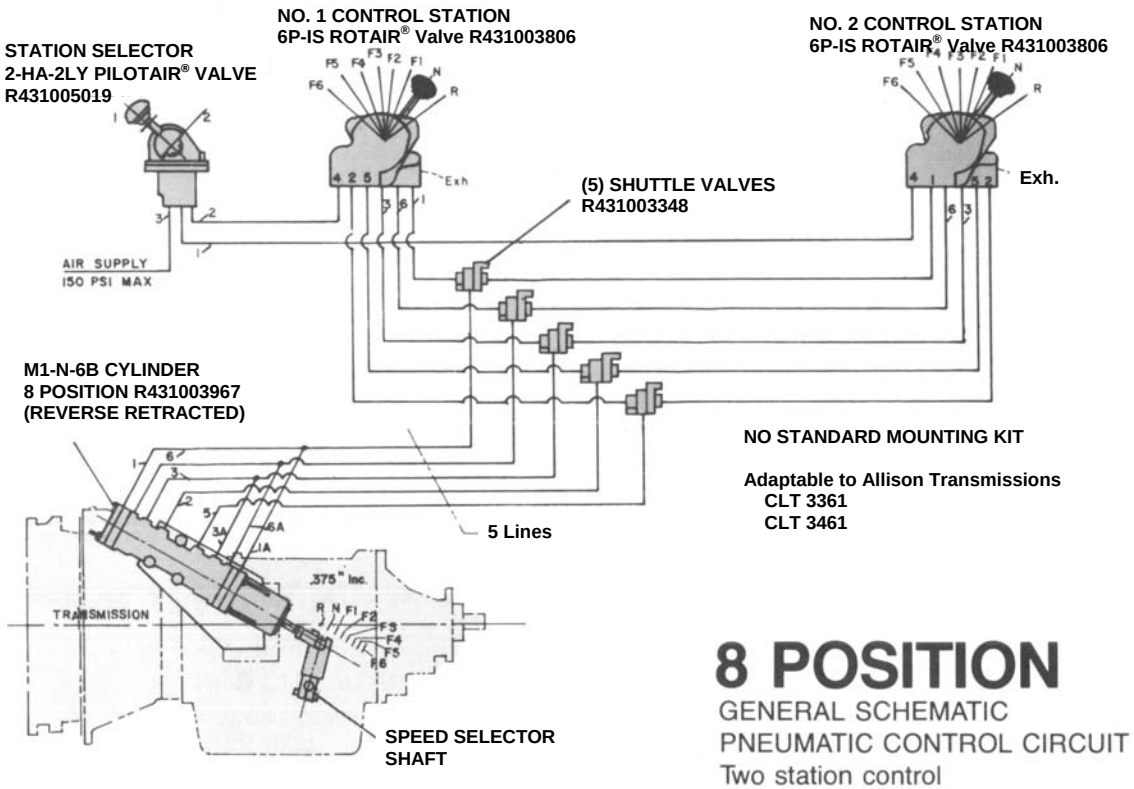
6 POSITION

GENERAL SCHEMATIC
PNEUMATIC CONTROL CIRCUIT
Two station control
Automatic mode



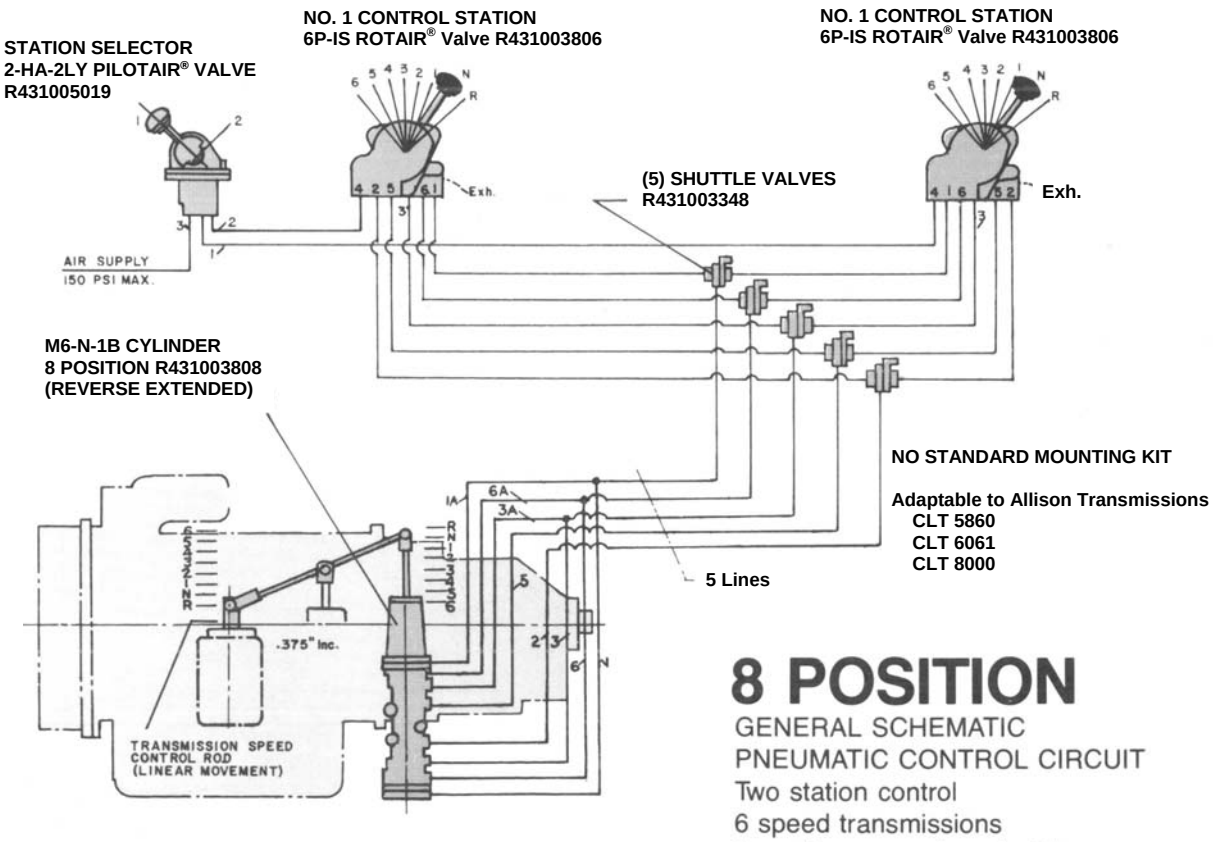
8 POSITION

GENERAL SCHEMATIC
PNEUMATIC CONTROL CIRCUIT
Two station control
6 speed transmissions
8 position manual control-rotary



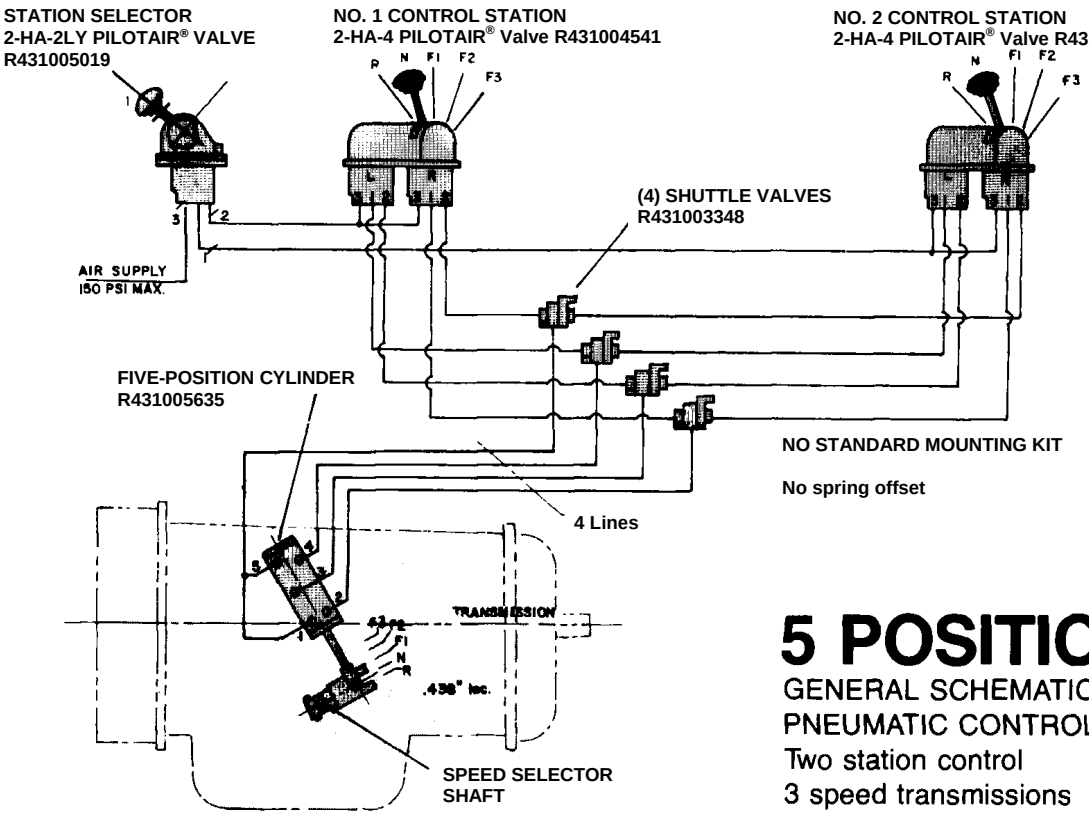
8 POSITION

GENERAL SCHEMATIC
PNEUMATIC CONTROL CIRCUIT
Two station control
6 speed transmissions
8 position manual control-rotary



8 POSITION

GENERAL SCHEMATIC
PNEUMATIC CONTROL CIRCUIT
Two station control
6 speed transmissions
8 position manual control-linear



5 POSITION

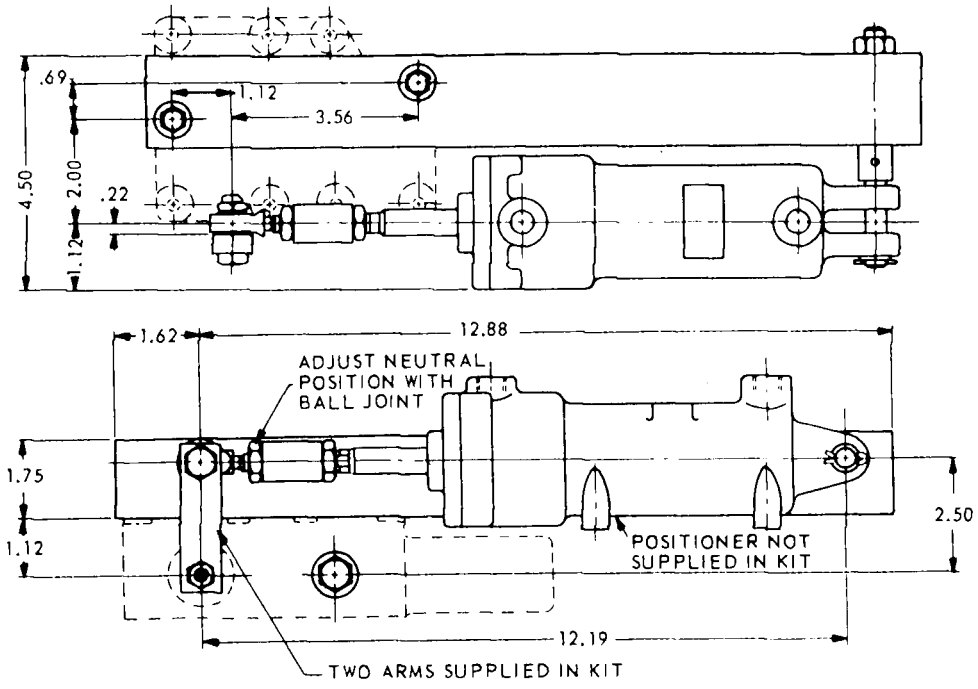
GENERAL SCHEMATIC
PNEUMATIC CONTROL CIRCUIT
Two station control
3 speed transmissions
5 position manual control

Mounting Bracket Kit for Sundstrand Pumps

Part Number R431006426 (old part no. P –064424-00000)
Bracket and hardware for mounting AVENTICS positioner part number R431005261 to Sundstrand pump models 20 through 28.

Dimension Reference

Mounting Bracket
R431006426



NOTICE TO PRODUCT USERS

1. WARNING: FLUID MEDIA

AVENTICS pneumatic devices are designed and tested for use with filtered, clean, dry, chemical free air at pressures and temperatures within the specified limits of the device. For use with media other than air or for human life support systems, AVENTICS must be consulted. Hydraulic cylinders are designed for operation with filtered, clean, petroleum based hydraulic fluid; operation using fire-resistant or other special types of fluids may require special packing and seals. Consult the factory.

2. WARNING: MATERIAL COMPATIBILITY

Damage to product seals or other parts caused by the use of non-compatible lubricants, oil additives or synthetic lubricants in the air system compressor or line lubrication devices voids the AVENTICS warranty and can result in product failure or other malfunction. See lubrication recommendations below.

AIR LINE LUBRICANTS! In service higher than 18 cycles per minute or with continuous flow of air through the device, an air line lubricator is recommended.* (Do not use line lubrication with vacuum products.) However, the lubricator must be maintained since the oil will wash out the grease, and lack of lubrication will greatly shorten the life expectancy. The oils used in the lubricator must be compatible with the elastomers in the device. The elastomers are normally BUNA-N, NEOPRENE, VITON, SILICONE and HYTREL. AVENTICS recommends the use of only petroleum based oils without synthetic additives, and with an aniline point between 180° F and 210° F.

COMPRESSOR LUBRICANTS! All compressors (with the exception of special "oil free" units) pass oil mist or vapor from the internal crankcase lubricating system through to the compressed air. Since even small amounts of non-compatible lubricants can cause severe seal deterioration (which could result in component and system failure) special care should be taken in selecting compatible compressor lubricants.

3. WARNING: INSTALLATION AND MOUNTING

The user of these devices must conform to all applicable electrical, mechanical, piping and other codes in the installation, operation or repair of these devices.

INSTALLATION ! Do not attempt to install, operate or repair these devices without proper training in the technique of working on pneumatic or hydraulic systems and devices, unless under trained supervision.

Compressed air and hydraulic systems contain high levels of stored energy. Do not attempt to connect, disconnect or repair these products when a system is under pressure. Always exhaust or drain the pressure from a system before performing any service work. Failure to do so can result in serious personal injury.

MOUNTING! Devices should be mounted and positioned in such a manner that they cannot be accidentally operated.

4. WARNING: APPLICATION AND USE OF PRODUCTS

The possibility does exist for any device or accessory to fail to operate properly through misuse, wear or malfunction. The user must consider these possibilities and should provide appropriate safe guards in the application or system design to prevent personal injury or property damage in the event of a malfunction.

5. WARNING: CONVERSION, MAINTENANCE AND REPAIR

When a device is disassembled for conversion to a different configuration, maintenance or repair, the device must be tested for leakage and proper operation after being reassembled and prior to installation.

MAINTENANCE AND REPAIR! Maintenance periods should be scheduled in accordance with frequency of use and working conditions. All AVENTICS products should provide a minimum of 1,000,000 cycles of maintenance free service when used and lubricated as recommended. However, these products should be visually inspected for defects and given an "in system" operating performance and leakage test once a year. Where devices require a major repair as a result of the one million cycles, one year, or routine inspection, the device must be disassembled, cleaned, inspected, parts replaced as required, rebuilt and tested for leakage and proper operation prior to installation. See individual catalogs for specific cycle life estimates.

6. PRODUCT CHANGES

Product changes including specifications, features, designs and availability are subject to change at any time without notice. For critical dimensions or specifications, contact factory.

*Many AVENTICS pneumatic valves and cylinders can operate with or without air line lubrication; see individual sales catalogs for details.

-Refer to the appropriate service manual for parts and service information, most are available for download from www.aventics.com/us

LIMITATIONS OF WARRANTIES & REMEDIES

AVENTICS warrants its products sold by it to be free from defects in material and workmanship to the following:
For twelve months after shipment AVENTICS will repair or replace (F.O.B. our works), at its option, any equipment which under normal conditions of use and service proves to be defective in material or workmanship at no charge to the purchaser. No charge will be made for labor with respect to defects covered by this Warranty, provided that the work is done by AVENTICS or any of its authorized service facilities. However, this Warranty does not cover expenses incurred in the removal and reinstallation of any product, nor any downtime incurred, whether or not proved defective.
All repairs and replacement parts provided under this Warranty policy will assume the identity, for warranty purposes, of the part replaced, and the warranty on such replacement parts will expire when the warranty on the original part would have expired. Claims must be submitted within thirty days of the failure or be subject to rejection.
This Warranty is not transferable beyond the first using purchaser. Specifically, excluded from this Warranty are failures caused by misuse, neglect, abuse, improper operation or filtration, extreme temperatures, or unauthorized service or parts. This Warranty also excludes the use of lubricants, fluids or air line additives that are not compatible with seals or diaphragms used in the products. This Warranty sets out the purchaser's exclusive remedies with respect to products covered by it, whether for negligence or otherwise. Neither, AVENTICS nor any of its affiliates will be liable for consequential or incidental damages or other losses or expenses incurred by reason of the use or sale of such products. Our liability (except as to title) arising out of the sale, use or operation of any product or parts, whether on warranty, contract or negligence (including claims for consequential or incidental damage) shall not in any event exceed the cost of replacing the defective products and, upon expiration of the warranted period as herein provided, all such liability is terminated. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WHETHER FOR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE. No attempt to alter, amend or extend this Warranty shall be effective unless authorized in writing by an officer of AVENTICS Corporation.
AVENTICS reserves the right to discontinue manufacture of any product, or change product materials, design or specifications without notice.

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The data specified only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.